Reconceptualising knowledge seeking in knowledge management: towards a knowledge seeking process model

HAN LAI

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Abstract

Promoting knowledge sharing has long been regarded as a very important aspect of the management of knowledge. However, knowledge sharing has its challenges due to the special nature of knowledge. Based on this, the researcher argues that it is knowledge seeking rather than knowledge sharing that plays a crucial role in knowledge management. However, there is no clear definition for knowledge seeking in existing literature. In the few studies of knowledge seeking research, knowledge has been viewed as a noun and as such knowledge seeking has been seen as no different to information seeking. The aim of this research has been to explore the knowledge seeking process in the workplace in order to conceptualise knowledge seeking by developing a theoretical model.

A review of the literature concerning knowledge seeking has been conducted in order to clarify the concept of knowledge seeking. From the interpretivist's perspective, a qualitative research approach has been taken, in which sense-making theory is employed as a methodological guide. Time-line interviews were carried out with construction engineers in China to collect primary data, and Template analysis was utilized.

Based on the literature, this thesis defined knowledge seeking as a learning process, which consists of three major themes: experiential learning, information seeking and problem solving, based on which a preliminary framework was developed. Twenty six engineers were successfully interviewed. The findings from the data confirmed the links between the themes. Further codes were also identified to develop a final template, which evolved to a theoretical model illustrating the knowledge seeking process in the workplace.

By promoting knowledge seeking rather than knowledge sharing, this research contributed innovatory insight into existing KM research. The new concept of knowledge seeking and the theoretical model developed thereafter contribute to knowledge by providing a theoretical framework for further research in this area. The specific combination of time-line interviews and template analysis has demonstrated good results in this research. Collecting primary data from China, this research applied Western theories onto engineers within a Chinese context, which has contributed to KM research in China. These contributions will result in many practical implications for KM practices.

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Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the School Ethics Committee.

Name: HAN LAI

Signature:

Date:

____CHAPTER ONE ____

Introduction

1-1 Background of the KM Development

Peter Drucker, a founding figure of modern management, developed a post-capitalist society perspective and outlined early ideas for knowledge-based society. He introduced the term ‘knowledge worker’ and pointed out that management should respond to this transition to fulfil the characteristics of knowledge work. If we regard this notion of the knowledge worker heralding the beginning of knowledge management (KM), the introduction of the concept of ‘management of knowledge’ at a European management conference in 1986 (Wiig, 1997) could be seen as the beginning of research into this concept. From then on, KM practices and research has been growing rapidly, and has become a topic that is central to management research. This rapid development of KM is attributed to three key drivers, namely economic driver, social driver, and organizational driver:

1-1-1 The economic driver for KM

Economic growth and society development have long been the themes around the world. From an economist's perspective, there are many factors contributing to economic or productivity growth. Early economic growth models mainly focused on the capital factors, until Solow (1956) proposed his economic growth model, which has been widely named as a neoclassical growth model. According to Solow's (1956) growth model, the input to an economy is very important, and the growth rate of output is equal to the rate of input. The main inputs include labour and capital. However, these two factors only have short run implications for economic growth as the economy converges to the new steady state output level. The long-run rate of growth in this model will be exogenously determined by the rate of technology progress. Solow's model takes technological advancement into account and regards the level of technology as a parameter in it. Since then, knowledge and technological advancement have become more and more important in economists' theories.

Although the neoclassical model views technology as an exogenous parameter, it does not explain how and why technological progress occurs. After Solow (1956), many economists have expanded his model and developed many new models, which endogenize technology and knowledge factors, and thus are named as endogenous economic growth models (such as Romer, 1986; Grossman & Helpman, 1990). On the one hand, they expanded capital factors from merely physical capital to human capital in their models. On the other hand, they proposed to increase production by means of expanding its scope and improving its quality.

This evolution in the new economic growth models demands technological advancement. Compared to the neoclassical models, the new models have attached more importance to technology and innovation. They regarded technological change or the introduction of new technology as the foundation of economic growth. Therefore, research and development (R&D), technological advancement, and innovation have become a main theme in economic growth and business, which becomes the economic driver for KM.

1-1-2 The social driver for KM

According to Hislop (2009), the theoretical foundations or key assumptions on which knowledge management literatures are typically based are the conceptions of the knowledge society (Drucker, 1966; 1969) or post-industrial society (Bell, 1974). Thus we will have a brief review of the social background of KM from the perspective of knowledge society or post-industrial society theorists.

The concept of the 'knowledge worker' was first introduced by Drucker (1966) in his book 'The Effective Executive'. He distinguishes the 'knowledge worker' from the traditional 'manual worker' who just works with their hands to provide goods or services. Knowledge workers, on the contrary, tend to work with their heads to produce ideas, information or knowledge. In another book, Drucker (1969) continued to propose his ideas, and described the idea of a knowledge society. He employed the concept of 'discontinuity' to depict the shifts in the foundations or the major changes in the underlying social and cultural reality. These emergent changes or 'discontinuity' in our society include the rapid emergence of new technologies, a world economy, a new pluralism of institutions, and the knowledge economy.

It is proposed that management should respond to this transition to fit the characteristics of knowledge work. Namely, these social changes call for new approaches from managers and knowledge workers.

The concept of the ‘post-industrial society’ was mainly introduced by Daniel Bell (1974) to depict the social change from the middle of the nineteenth century. According to Bell, an industrial society is mainly based on manufacturing and fabrication; while in a post-industrial society, the biggest source of employment is no longer the manufacturing sector, but the service sector, in which knowledge and information play a more important role. For Bell, the professional service work will become critical in a post-industrial society as it dramatically demands the application of knowledge. However, there is still some debate around the concepts of ‘post-industrial society’, such as whether there is a necessary connection between service sector jobs and knowledge work. Some service sector work, such as research and consultancy, can be categorized as knowledge intensive sectors, while some other service works, such as security or cleaning jobs, are not. So it is not precise to regard all service sector jobs as being knowledge intensive. Although there is statistical evidence that the growth in professional and managerial work has been one of the most dramatic ones among other occupational groups since the 1980s, Hislop (2009, p7) argues that “…the idea that there is a universal increase in the knowledge intensity of work in general is simplistic and a little misleading”. However, these debates by no means imply that our society is unchanged. They might be arguing whether these changes represent a fundamental break in society.

All in all, since much work has become knowledge intensive, the nature of work has changed and knowledge has become the key asset for contemporary business organizations. This largely demands the employment of knowledge workers and the effective management of the knowledge in organizations. It is such a revolutionary change in our society and it explains the growth of interest in knowledge management since the 1990s.

1-1-3 The organizational driver for KM

‘Competitive Advantage’ has long been discussed by researchers and managers alike. Porter (1985) defined competitive advantage as the ability to earn returns on investment consistently above the average for the industry. From the perspective of ‘resource- based theory’, a firm is like a pool of hard-to-copy resources and capabilities, and its strategy should focus on costly-to-copy attributes of the firm (Conner, 1991). Namely, organizational sustained superior performance lies in its inimitable resources. According to ‘resource-based theory’, resources and products are two sides of one coin for a firm, and the ability to gain and defend advantageous positions in underlying resources, which is important to production and distribution, is critical for a firm to keep profitable market positions.

A firm’s resources include not only physical, or tangible resources, but also intangible resources. According to Halawi et al. (2005), valuable, uncommon, and poorly imitable resources comprise a firm’s unique competencies and therefore present a lasting competitive advantage. In addition, intangible resources are normally more likely to gain this advantage than tangible sources. It is reasonable to argue that distinct knowledge should give the firm a competitive advantage. As stated by McEvily and Chakravarthy (1997, p1), “knowledge is presented as a particularly important resource in this regard”. It has been generally proposed that sustainable competitive advantage is no longer rooted in physical assets or financial capital, but intellectual capital or knowledge (Sveiby, 1986; Drucker, 1993; Roos, et al., 1997; Koenig, 2002).

McEvily and Chakravarthy (1997) even conducted an empirical investigation to explore whether and when the key characteristics of knowledge in a firm lead to a competitive advantage. They argue in their research that the imitation barrier of a firm is also determined by the characteristics of technological knowledge, namely complexity, tacitness, and specificity. A survey instrument was developed to measure the three characteristics and the persistence of a firm's product performance advantage. The findings of the survey supported their hypotheses: the complexity and tacitness of technological knowledge are positively related to the persistence of a firm's product performance advantages.

Thus, how to manage knowledge inside an organization to gain competitive advantages becomes very important, especially in today's fiercely competitive business environment. This has become an organizational driver for the development of knowledge management.

1-2 Research Background

As stated by Kakabadse et al. (2003), there are various disciplines that have influenced and informed the field of KM thinking and practices including: philosophy, cognitive science, social science, management science, artificial intelligence, and so on. Consequently, there are lots of definitions of knowledge management and different KM practices.

According to Sveiby (2001), there are two broad approaches (or two tracks of activities) to knowledge management among the extant literature. One is IT-Track KM. It is based on the so-called ‘hard’ aspect, which focuses on the deployment and use of information technology. While the other one is People-Track KM. It is based on the so-called ‘soft’ aspect, which focuses on the capture and sharing of knowledge from the knowledge person to knowledge seekers. The first categorization of KM focuses on the management of information, while the second one centres on the management of people (Sveiby, 2001). The second categorization of KM takes an epistemological view of knowledge and regards knowledge as a social process. This scientific and philosophical view of the nature of knowledge itself has been accepted by many KM gurus, such as Nonaka and Takeuchi (1995), Davenport and Prusak (1998), Lave and Wenger (1991), and so on.

According to Szulanski (2000, p10), “the mere possession of potentially valuable knowledge somewhere within an organization does not mean that other parts of the organization benefit from this knowledge”. Based on this kind of assumption, many researchers or practitioners thus emphasise the importance of knowledge transfer within the organization or between organizations (such as Li-Hua, 2006). As a result, knowledge sharing, as the major method of knowledge transfer, becomes the starting point of knowledge management. It has become one of the main goals of KM initiatives to encourage and improve knowledge sharing within organizations. As stated by Wang and Noe (2010, p115), “knowledge sharing is the fundamental means through which employees can contribute to knowledge application, innovation, and ultimately the competitive advantage of the organization”. For the most part, they normally focus on identifying the factors influencing individuals share their knowledge with others. These factors are normally from two major areas: organizational contexts, and individual & interpersonal factors. Factors from the organizational context include organizational structure, hierarchies, formal processes, leadership, and cultures (Sondergaard et al. 2007; Al-Alawi et al., 2007; McDermott & O'Dell, 2001). Research addressing individual & interpersonal factors mainly focus on staff's attitudes, behaviours, or individual personalities and dispositions on knowledge sharing (such as Judge and Bono, 2001; Cabrera et al., 2006; Lin, 2007); or motivational factors (such as Wasko & Faraj, 2000; Hew & Hara, 2007); or interpersonal relationship and social networks (such as Robinson, 1996; Abrams et al., 2003; Regans & McEvily, 2003; Cross & Cummings, 2004).

In KM practice, many organizations have invested large amounts of time and money to develop knowledge management systems employing state-of-the-art technologies to facilitate important knowledge sharing activities. However, according to recent studies (Babcock, 2004), this investment results in huge financial losses among Fortune 500 companies, at least $31.5 billion per year, due to the failure of sharing knowledge. Bearing in mind that knowledge sharing, as a major way to transfer knowledge, has long been regarded as the foundation of knowledge management, it is thus reasonable to ask some fundamental questions around knowledge sharing: what are the barriers to knowledge sharing? Is knowledge sharing the fundamental means of knowledge management? These questions around knowledge sharing led the author to conduct this PhD research programme to explore new approaches promoting knowledge management in organizations.

1-3 Statement of the research problem

So what are the barriers to knowledge sharing? Firstly, an individual might ask why they should share their knowledge. From an economic perspective, the primary motivation of behaviour is self-interest and knowledge sharing is similar to other traditional economics of tangible resources, which can be explained by a cost-benefit analysis. Based on this economic perspective, the scarcity of knowledge decides its value. Those who own the scarce knowledge will take great advantages within or among organizations. Thus the costs and benefits of sharing knowledge should be taken into account. The people who own such scarce and important knowledge would ask for some benefit from the receivers or the organizations, as they might lose their advantages of their benefit might be damaged if they share their knowledge to others. In this sense, why should I share my scarce knowledge? As stated by Christensen (2005), knowledge sharing is an exchange process where the individual offers something of value while receiving something of value. Therefore, knowledge sharing is a kind of exchange that should be an interactive process. The giving and receiving takes place in a knowledge sharing process at the same time. Apparently, it will be really tricky to request people to simply share their knowledge, as we are asking people to do what they do not want to do.

The second barrier around knowledge sharing concerns what knowledge an organization should rely on to gain competitive advantage. According to the perspective of knowledge sharing, individuals have knowledge in their minds, and this knowledge should be shared and transferred in organizations. This implies an apparent assumption that what 'knowledge sharing' deals with is actually the existing knowledge in organizations. It is true that sharing existing knowledge within organizations will help them to effectively utilise available resources. However, is the existing knowledge updated, or validated in the changing environment? Can the existing knowledge be utilized with a 'one size fits all' mentality? Finally, can knowledge sharing alone help organizations gain or maintain their competitive advantages?

Furthermore, as knowledge sharing implies the transferring of some knowledge from one person to another, it is often expected to result in copying, not the creation of new knowledge. New knowledge, namely knowledge creation, has become increasingly important for organizations, as it is the source of competitive advantage. Knowledge management, as a new management concept, is supposed to help organizations in creating and leveraging new knowledge to gain or maintain the competitive advantages. According to Coulson-Thomas(2004), KM should be an end-to-end process from identifying knowledge requirements, to the creation, sharing, and application of knowledge, to enable innovation and deliver additional income streams. However, he continues arguing, most KM initiatives focus exclusively on knowledge sharing sections of the process, while the knowledge creation and exploitation aspects tend to be missing. “Copying and sharing commodity knowledge is not the route to market leadership” (Coulson-Thomas 2004, p88).

The third barrier around knowledge sharing is about what initiates the process of knowledge transfer in organizations. Is it the sharer who pushes his knowledge onto others, or the seeker who actively pulls knowledge towards him/her? What makes the so-called transfer process happen at the very beginning, when knowledge is still in the knowledge sharer’s mind? Actually, this barrier has long been regarded as referring to two different approaches in knowledge management: knowledge push (or supply-driven) approaches and knowledge pull (or demand-driven) approaches (Scarbrough, Swan & Preston, 1998; McElroy, 2003). Apparently, as knowledge sharing is regarded as a foundation of KM, the knowledge push approaches have dominated KM literature and practices, which emphasise the employment of information technology to enhance the knowledge capture, knowledge codification, and knowledge storing, especially the creation of knowledge databases, such as so-called expert systems, or knowledge repositories. However, knowledge is special and personal. It is embodied and resides in the head of those who developed or constructed it in their mind. Simply delivering or 'pushing' information to a user's desktop may not be an effective approach to the management of knowledge, due to the lack of the user's attention that is required for processing this information and constructing it into knowledge. According to Dougherty (1999, in Li-Hua, 2006), Knowledge transfer is about connection not collection, and that connection ultimately depends on choices made by individuals. This implies the "two-way process" between the transferor and the transferee. Knowledge will not be 'pushed' or 'shared' if the 'seeker' cannot or does not 'pull', or strictly speaking, construct the knowledge by themselves.

The barriers of knowledge sharing above demonstrate some fundamental problems. First of all, people are reluctant to share their knowledge with others without any exchange or rewards. We are actually asking people to do what they do not want to do when we emphasize knowledge sharing. Secondly, knowledge sharing is actually focusing on the existing knowledge, but the utilization of existing knowledge is not enough in today's changing environment. We need to create new knowledge to gain or maintain competitive advantage.

Thirdly, knowledge sharing is trying to push so-called knowledge to others while, as a result of the special attributes of knowledge, the 'pulling' from the knowledge seeker is the key point in the ‘knowledge transfer’ process.

This PhD researcher firmly stands on this point that it is knowledge seeking rather than knowledge sharing, among others, that makes knowledge transfer or knowledge creation possible. This implies that it is not enough just to emphasize the knowledge sharing and stress on the knowledge sharer or pushing side. We should pay more attention to the opposite side of knowledge sharing, to those who actively seek solutions for the problems or challenges they meet at work, namely 'knowledge seeking'. Thus, there is an apparent need to explore how knowledge seeking will take place, and what factors might be involved in this process. Obviously, knowledge management could be remarkably improved if we are able to understand this process.

Notwithstanding, there is no clear definition for knowledge seeking in the KM literature as far as this author is concerned, although some researchers have explored this area. Various notions have been employed with different foci referring to the knowledge seeking process, such as knowledge acquisition, knowledge sourcing, knowledge creation, and even information seeking. In some studies, they are seen as overlapping and difficult to differentiate.

In research employing the notion of 'knowledge seeking', the term mainly refers to behaviours of people seeking knowledge from an Electronic Knowledge Repository (EKR), for example, Kankanhalli, Tan, and Wei (2001). Knowledge is regarded as an object or entity, and it is commonly assumed that individuals can find it out when needed. In 2005, Kankanhalli et al

(2005) conducted further research to formulate and test a theoretical model explaining EKR usage by knowledge contributors. Following Kankanhalli, Tan, and Wei's (2001) study, Sanjeev and Gee-Woo (2005) employed the Decomposed Theory of Planned Behaviour and Technology Acceptance Model to investigate the factors influencing individual's knowledge seeking behaviour in EKR, providing an understanding of the underlying psychological processes in knowledge seeking.

There are some other notions used in the KM literature similar to the meaning of knowledge seeking, for example, knowledge sourcing, and knowledge acquisition, Gray and Meister (2004; 2005) use 'knowledge sourcing' to describe the activities in organizations in which individuals intentionally access each other's expertise, experience, insights, and opinions. Knowledge acquisition is another statement related to knowledge seeking in KM literature. However, knowledge acquisition in most related literature is mainly about so-called knowledge-based systems or expert systems from a computing science perspective. As stated by Brewster, Ciravegna and Wilks (2002), for knowledge to be managed it must first of all be captured or acquired in some useful form, e.g. stored in an ontology. Thus knowledge acquisition refers to such activities in knowledge management. In these researches, knowledge acquisition implies how we extract knowledge from experts and represent it in a knowledge-based system. According to Gebus and Leiviska (2007), this activity is normally carried out by a knowledge engineer. From a computing science perspective, research in knowledge acquisition focuses on how to employ or develop new techniques to extract knowledge, how to define the ontology in the database, and how to automate the knowledge acquisition process to reduce time or cost, and so on.

Although few in number, we have to acknowledge that some researchers have focused on the knowledge recipients or seekers side of knowledge management. However, if we compare the notion of ‘knowledge seeking’, ‘knowledge sourcing’, or ‘knowledge acquisition’ in existing research to ‘information seeking’, we notice that these notions of ‘knowledge seeking’ are actually not different from ‘information seeking’. Researchers tend to take it for granted that we will get more knowledge if we find more information. Or they think knowledge is just over there (in books, documents, database, or human mind). What we need to do is to fetch them.

Considering the differences between knowledge and information, and the extraordinary nature of knowledge, existing research in the knowledge seekers’ side have simplified the knowledge seeking process, neglecting the active knowledge construction process. This leads to the question for this research: How can we better define and conceptualize knowledge seeking for effective management of knowledge in organizations?

1-4 Research Aim and Objectives

Considering the importance of the knowledge seeker’s dynamic role in knowledge management and the existing research in this area, there is a need to explore this knowledge seeking process in the workplace. This naturally leads to the aim of this PhD study:

To explore the knowledge seeking process in the workplace.

Bearing this purpose in mind, the following objectives have been identified:

1. To review the literature addressing the definition and meaning of knowledge and knowledge management to clarify the notion of ‘knowledge seeking’;

2. To review the literature concerning how knowledge is sought in the workplace in order to develop a preliminary framework for knowledge seeking;

3. To conduct time-line interviews among construction engineers in China in order to collect primary data for the understanding of knowledge seeking;

4. To develop a theoretical model conceptualizing knowledge seeking that integrates key elements of the process by analysing the data collected.

1-5 A brief description of research methodology

According to Myers and Avison (2002), the ‘positivist’ researcher assumes that reality is objectively given and can be described by measurable properties. However, ‘constructivism’ assumes that all knowledge, or all meaningful reality, is contingent upon human practices, being constructed in and out of interaction between human beings and their world (Crotty, 1998). Patton (2002) also pointed out that ‘Truth’ is a matter of consensus among informed and sophisticated constructors, not of correspondence with objective reality. This means knowledge cannot be described simply as objective or subjective. Knowledge is not a noun, but a verb or a process. We cannot create ‘knowledge’ but we may construct ‘knowledge’.

Then the knowledge seeking process is the process of the knowledge seeker constructing knowledge in their minds. Based on constructivism, this research is not focusing on the knowledge itself in organizations, but on the way in which knowledge is continually being constructed by individuals through the seeking process.

In qualitative research, the research topics and the methodological approach employed will decide the sampling process (Higginbottom, 2004). However, as an international student initially attempting to conduct a cross-cultural research among different nations, convenience is always the first choice. Considering the purpose of this research, construction engineers as knowledge workers named by Drucker (1966) were initially selected as target sample after the researcher contacted some acquaintances. Although the research aim had been adapted later on from the cross-cultural research to exploring the individual knowledge seeking process alone, a brief review of the literature concerning knowledge management and construction industry still justified the choice: construction engineers in China.

As a project-based business, construction industry is a knowledge intensive industry featured with a temporary nature and fragmentation. This makes construction a very complex process, which results in poor efficiency of the overall process (Dave and Koskela, 2009). To face the challenges, Ribeiro (2009) argues that construction firms must learn to gather, share, and reuse project knowledge, and lessons learned from previous projects. According to research (Hall & Spased, 2005; Dave & Koskela, 2009), if the knowledge from construction projects can be captured and reused, the process efficiency will be improved and the waste reduced.

However, there is only a limited number of empirical studies on KM in construction firms (Chen and Mohmed, 2006), and it is still unknown from the related literature how to enhance the knowledge sharing and exchange in the construction industry (Ribeiro, 2009). This indicates a lack of research in knowledge transfer in this industry, let alone knowledge seeking research.

In view of the above situation in this industry, construction engineers were convincingly justified as the target sample for this PhD research. Through contacting industry contacts, the researcher approached target interviewees in China, who are architecture engineers from four construction engineering organizations located in three different cities in China. Twenty six construction engineers have been successfully interviewed to understand how they seek knowledge in their workplaces. This involved six kinds of engineers: road design engineer (RDE), urban planning engineer (UPE), architecture scheme engineer (ASE), construction design engineer (CDE), structural design engineer (SDE), building services engineer (BSE).

Interviews developed from sense making theory were employed to collect the primary data, and participants were asked to recall a typical task they had accomplished at work where they learnt about a specific problem situation. The respondents were then asked to describe in detail each step or situation they experienced in the process of completing the task. This focuses on specific moments when the respondent saw themselves as ‘encountering a problem’: what problem they met, what strategy they employed to solve it, from where and how they sought help or information, what experience they got by solving the problem, and what knowledge they gained through their experience. All the interviews were audio recorded, and transcribed.

Template analysis, using thematic coding, was adopted in this research for the data analysis. All the data analysis was conducted with the help of Nvivo, the software for qualitative data analysis. From the related literature, some key themes of the knowledge seeking process were identified and a preliminary framework was constructed, from which a priori codes were developed. These a priori codes were then applied to the first transcripts in order to develop an initial template. After that, the codes from the initial template were applied to the rest of the transcripts for further analysis. At the end, a final template was identified, from which a process model of knowledge seeking was developed.

1-6 Research Contributions

- **Theoretical contributions**

Based on a thorough review of the literature, this thesis argues that it is knowledge seeking rather than knowledge sharing that makes knowledge transfer or knowledge creation possible in knowledge management. This novel perspective contributes to existing knowledge management theories by extending KM research from the emphasis on knowledge sharing alone to knowledge seeking.

This PhD research links experiential learning, information seeking and problem solving together. It is argued that it is such links that constitute a knowledge seeking process. The concept of knowledge seeking is therefore defined as a learning process consisting of these three themes. A process model is developed which contributes to existing knowledge by providing a theoretical framework for further research in this area.

The combination of time-line interviews and template analysis also contributes to the existing body of knowledge, especially in the research method area. It extends the application of sense-making theory, which is mainly used in information behaviour research and companied by a content analysis. This tentative application contributes to the existing body of knowledge by providing a new method which can be developed further in theory and practice.

- **Practical contributions**

The new perspective on knowledge seeking in this thesis implies that it is not enough just to emphasize the knowledge sharer, but instead we should pay more attention to the opposite side: the knowledge seeker. This innovatory perspective will practically contribute to knowledge management initiatives in management activities. The knowledge seeking process model developed in this research contributes to practice by helping us understand the process. It provides the leaders or managers of organizations with insight into how we seek knowledge in a workplace, which might improve our management to support the knowledge seeking process.

Collecting primary data from China, this research develops deep insights into knowledge seeking behaviour, by applying Western theories onto construction engineers within a Chinese context. This practically contributes to the Chinese construction industry, particularly to the effective knowledge transfer between the managers and engineers themselves in China.

1-7 Structure of the Thesis

Following this introductory chapter, Chapter Two reviews the subject of knowledge management, providing an overview of knowledge management in theory and practice, such as the definitions of knowledge management, different perspectives on knowledge management models, cycles, and strategies, and different understanding of knowledge in knowledge management.

In Chapter Three, the challenges knowledge sharing is faced with are discussed. Based on this discussion, knowledge seeking is introduced.

Chapter Four provides a review of three research areas which related to knowledge seeking: information seeking, problem solving, and learning in a workplace. Based on the related literature reviewed, the underlying links among the literature related to knowledge seeking is discussed. A preliminary framework for knowledge seeking is developed thereafter. Some a priori codes for knowledge seeking are also identified from the literature.

Chapter Five revisits the process of this research and the understanding of research philosophy and method. After that, the theoretical perspectives and research methods that underpin this research are discussed. This is followed by a discussion of how primary data was collected based on sense-making theory, and how the data was analyzed based on template analysis approach. The ethical considerations concerning this research are stated at the end of this chapter.

The primary data collected are interpreted and discussed in Chapter Six, Research findings from the data analysis are presented in Chapter Seven. The last chapter, Chapter Eight, reviews this PhD research by examining if the objectives are achieved. The main findings from data analysis are presented. The research contributions, implications, limitations, and recommendations are highlighted ending with ideas for further research.

___CHAPTER TWO ___

Knowledge Management in Theory and Practice

2-1 Introduction

The past two decades have witnessed an increasing volume of research and practice in the topic of KM. The emergence and development of KM has been rapid and even a little chaotic. The definitions of KM are various as many disciplines have informed it. It is thus necessary to have a review of the KM literature to gain a complete understanding of KM: What is KM? Where and how KM comes from? What are the main themes or perspectives in this area? This chapter seeks to answer these questions, providing an overview of KM. After the different definitions of KM are clarified, the development of KM will be reviewed, exploring the origins of KM and thus explaining the complexities in this area. Next, the review will cover knowledge management models as the theoretical foundation or paradigms for KM, knowledge management cycles as descriptions of major phases or steps involved in KM, and knowledge management strategies as the ways or approaches to manage knowledge in organizations. After that, the conception of knowledge in KM will be discussed by reviewing the different understandings of knowledge in current KM literature.

2-2 What is Knowledge Management?

2-2-1 Knowledge management definitions

A review of the existing literature reveals various definitions of KM. As a term, ‘knowledge management’ means something different to different people due to different assumptions, perspectives or purposes. Just like the syndrome ‘Blind men and the elephant’, different points of view lead to different definitions (see table 2-1).

For some researchers (such as Gupta et al., 2000; Xia et al., 2003; Zhang and Zhao, 2006), KM is actually a new form of information management. They employ the term of ‘information’ to define KM. As stated by Zhang and Zhao (2006), “KM is the study of strategy, process, and technology to acquire, select, organize, share, and leverage business-critical information”. According to some other researchers, however, knowledge is a kind of assets for organizations: intellectual assets (such as Grey, 1996; Snowden, 1998), or intangible assets (such as Sveiby, 1997), or knowledge assets (such as Wiig, 1997b). For these researchers, KM is the management of these assets. There are still some other researchers who neither use the term of ‘asset’, or mention the term of ‘information’. They just use the term of ‘knowledge’. For example, Petrash (1996) defines that KM is getting the right knowledge to the right people at the right time so they can make the best decisions. Davenport & Prusak (1998) define KM as the process of capturing, distributing, and effectively using knowledge.

Table 2-1: Some definitions of knowledge management

Authors	Year	Definitions
Grey	1996	Knowledge management is an audit of "intellectual assets" that highlights unique sources, critical functions and potential bottlenecks which hinder knowledge flows to the point of use.
Petrash	1996	KM is getting the right knowledge to the right people at the right time so they can make the best decisions.
Ouintas et al.	1997	KM is to discover, develop, utilize, deliver, and absorb knowledge inside and outside the organization through an appropriate management process to meet current and future needs.
Sveiby	1997	The art of creating value by leveraging the intangible assets.
Wiig	1997b	The systematic, explicit and deliberately building, renewal, and application of knowledge to maximize an enterprise's knowledge-related effectiveness and returns from its knowledge assets.
Davenport & Prusak	1998	KM is the processes of capturing, distributing, and effectively using knowledge.
Snowden	1998	The identification, optimization and active management of intellectual assets, either in the form of explicit knowledge held in artifacts or as tacit knowledge possessed by individuals or communities.
Gupta et al.	2000	KM is a process that helps organizations find, select, organize, disseminate, and transfer important information and expertise necessary for activities.
Alavi & Leidner	2001	KM is managing the corporation's knowledge through a systematically and organizationally specified process for acquiring, organizing, sustaining, applying, sharing and renewing both the tacit and explicit knowledge of employees to enhance organizational performance and create value.
Xia et al.	2003	The KM involves electronic transmission of information, verification of information resources and services, reconstitution of decision-making support tools and the life cycle of handling.
Zhang and Zhao	2006	KM is the study of strategy, process, and technology to acquire, select, organize, share, and leverage business-critical information.
Hislop	2009	KM is an umbrella term which refers to any deliberate efforts to manage the knowledge of an organization's workforce, which can be achieved via a wide range of methods including directly, through the use of particular types of ICT, or more indirectly through the management of social processes, the structuring of organizations in particular ways or via the use of particular culture and people management practices.

No big differences can be seen between these researchers although knowledge has been described differently in their definitions. Although different ways of KM are proposed by these researchers, one thing is sure: knowledge is important for organizations and we need to leverage it to improve organizational performance. Here, we are not going to take part in this definition war. Hislop's (2009) definition of KM will be adopted in this research as this definition is more recent and inclusive so that it contains different ways we manage knowledge in organizations:

> ***KM is an umbrella term which refers to any deliberate efforts to manage the knowledge of an organization's workforce, which can be achieved via a wide range of methods including directly, through the use of particular types of ICT, or more indirectly through the management of social processes, the structuring of organizations in particular ways or via the use of particular culture and people management practices. (Hislop, 2009 p59)***

The definition war above has shown us the complexity in the KM area. In order to gain a complete understanding of KM, it seems appropriate to have a look at the origins and development of KM, and to have a view of some important elements which have influenced KM perspectives. Where does KM come from? How was KM developed? The following section will address these points in detail.

2-2-2 Knowledge Management Development

Knowledge management practices have been around for a long time. Even in our ancient society, many KM techniques have been employed among teachers, writers, or librarians, such as some form of narrative repository, knowledge sharing by means of meetings, workshops, mentoring sessions, and so on. As stated by Dalkir (2005, p12), "the primary technology used to transfer knowledge consisted of the people themselves". Clearly, KM has been practiced implicitly as long as the human beings have thought seriously about their work.

However, the actual concept of KM has arrived relatively recently. It became popular only after the 1990s. Especially since 1998, KM practices and research have been booming rapidly (Grant and Grant, 2008). The very beginning of the concept of knowledge management might be traced back to the 1960s, when Peter Drucker coined the term 'knowledge worker' in his book 'The Effective Executive':

> ***"Every knowledge worker in a modern organization is an executive if, by virtue of his position or knowledge, he is responsible for a contribution that materially affects the capacity of the organization to perform and to obtain results."***
> ***(Drucker, 1966, p5)***

If we regard this notion of the knowledge worker as the beginning of knowledge management (KM), the introduction of the concept of 'management of knowledge' at a European management conference in 1986 (Wiig, 1997) could be seen as the start of KM research. From then on, KM practices and research became a central management topic throughout most of the world.

McElroy (2003) identified two generations of KM. According to him, the first generation of KM focuses on knowledge sharing or so-called ‘supply-side KM’, while the second generation emphasizes knowledge creation, so-called ‘demand-side KM’. Koenig (2002) proposed three stages of KM: In the first stage, KM mainly focuses on the use of ICT; the second stage, however, stresses socialization issues and emphasises the important role of organizational learning, knowledge creation, and community of practice; finally, the new generation of KM focuses on taxonomy development and content management. Snowden (2002) suggested another three-stage KM which consists of (1) the sharing and transfer of information for decision making, (2) the process of knowledge conversion between tacit and explicit knowledge, and (3) the centralization of context, narrative and content management.

Actually, many disciplines have informed KM development. As it has developed so rapidly and even a little chaotically, it is not easy to see a linear development in this area. The research in ‘Intellectual Capital’ by Sveiby and Risling (1986) has been seen as the start or origin of the KM movement (Grant & Grant, 2008; Koenig, 2002; Wiig, 1997; Martensson, 2000). From an economists’ perspective, knowledge will replace physical capital to become the basic economic resource. So they regard knowledge as being capitalised, namely ‘intellectual capital’. This perspective regards knowledge as a kind of resource that exists outside human and social systems, like land or oil. These resources include skills, information, copyright, R&D, and other intangible assets. Peters (1992) argues that KM concerns leveraging these intellectual capitals. This kind of viewpoint can be found in many other research, such as Brooking (1997), Roos, et al. (1997), and Edvinsson (1997).

Now that knowledge is strategically valuable for organizations, it is natural that advanced technologies can be employed to store and share it. The rapid development of information communication technology thus enabled good opportunities for knowledge management, especially since the 1990s when the personal computer and the internet were widespread. Based on the perspective of 'intellectual capital' and information management, knowledge management mainly refers to the employment of information and communication technology to facilitate the acquisition, storage, and sharing knowledge. Many types of software, such as Lotus Notes, and many so-called knowledge management systems have been developed since 1990s. This approach to KM has been called the 'IT-track' of knowledge management (Sveiby, 2001; Mason & Pauleen, 2003; Gao et al., 2008; Vorakulpipat & Rezgui, 2008; Grant & Grant, 2008).

Compared to the 'IT-track', another origin of knowledge management can be regarded as the 'Soft-track' of KM, which emphasises the social nature of knowledge, and mainly focuses on the management of people and social processes. There are three main influential works informing this 'soft' aspect of knowledge management: the 'learning organization' by Senge (1990), 'community of practice' by Lave and Wenger (1991), and the SECI model by Nonaka (1995).

The concept of the learning organization (LO) is usually connected to organizational learning (OL). There is also big confusion around these two concepts. Firestone & McElroy (2004) regard the LO as the 'normative aspect' of OL. Although the idea of organizational learning emerged earlier (such as Argyris & Schon, 1978), the major turning point was the work of Senge (1990), which is the most popular and foundational work in the area. The central themes of both OL and LO is whether learning can be managed and how. However, compared to the training and human resources literature, which mainly stress individual learning and staff development, OL and LO are concerned with collective learning. As Senge (1990) argues, the LO is where people are continually learning to see the whole together. Further discussion of organizational learning will be presented in Chapter Four.

Lave and Wenger (1991) introduced another concept, community of practice (CoP), into knowledge management. The CoP is defined as a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. In such a community, members are informally bound by what they do together. The CoP fulfils lots of functions with respect to the creation, accumulation, and diffusion of knowledge in an organization. Compared to the database and other repository, knowledge is retained in a 'living' way by a CoP (Kakabadse, 2003).

Nonaka's work and his SECI model (1995) can be regarded as one of the origins of KM because of its significant and influential role in this area, which has been evidenced by the fact that their work has become the most referenced material in this field. Referring to Polanyi's (1966) distinction between tacit and explicit knowledge, Nonaka focused on how knowledge was converted among the two different types. According to Nonaka (1995), in a knowledge creating company, tacit knowledge and explicit knowledge can be transferred through a spiral model which includes four steps: socialization, externalization, internalization, and combination. Apparently, Nonaka realised the social architecture of knowledge, and suggested that an appropriate environment should be created in organizations to provide a platform to share and create knowledge. He named this platform as a 'Ba'.

2-3 Knowledge Management models

For successful knowledge management, we must have a theoretical foundation, namely a conceptual framework or a paradigm for KM: a KM model. As mentioned previously, various disciplines have influenced and informed the field of KM theory and practices, and as a result, there are different KM models presented from different researchers. These models are built upon different philosophical assumptions or views. The current PhD researcher identifies two major categories among these KM models: knowledge category models, and socially constructed models. Knowledge category models are categorising knowledge into different types, and describing the movement of these different types, such as Wiig (1993), Nonaka & Takeuchi (1995), and Boisot (1998). Socially constructed models emphasize the social nature of knowledge, and stress its intrinsic link with the social and learning processes in organizations, such as Demerest (1997) and Jordon and Jones (1997).

Michael Polanyi (1966), from an epistemological perspective, distinguished knowledge into two dimensions: tacit knowledge and explicit knowledge. He defined tacit knowledge as being personal, context-specific, and therefore hard to formalize and communicate. On the other hand, explicit knowledge is transmittable in formal, systematic language. Based on this classification, Nonaka and Takeuchi (1995) developed their SECI model. According to Nonaka and Takeuchi, the core of knowledge management is to make personal knowledge become available in organizations and the knowledge creation process happens at all levels of the organization. They point out that this knowledge creation process actually is a knowledge conversion process between the two types of knowledge: tacit and explicit knowledge. There are four kinds of knowledge conversion: Socialization, externalization, combination, and internalization (see figure 2-1).

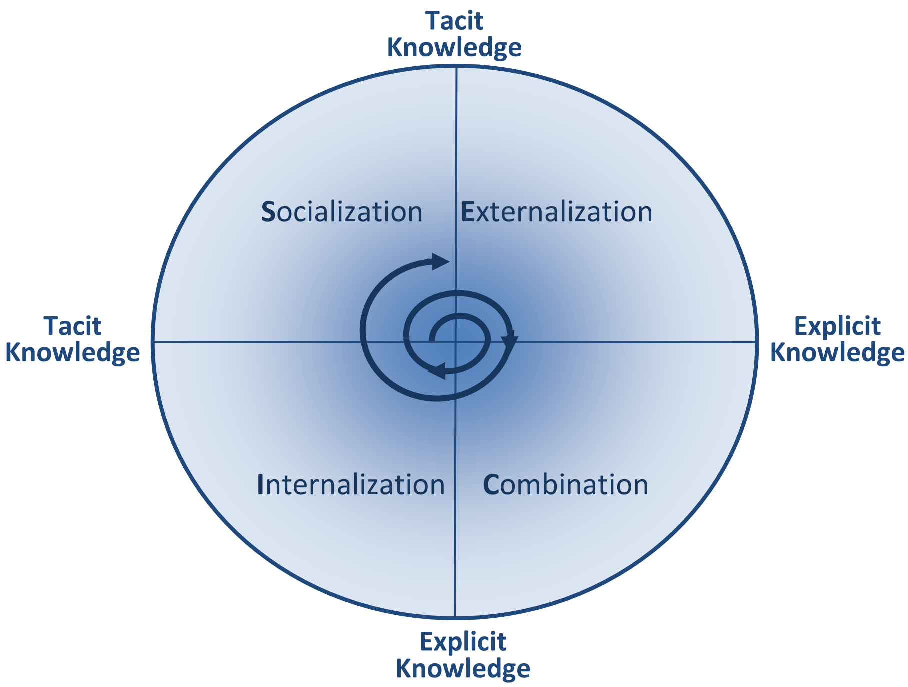


Figure 2-1: Nonaka & Takeuchi's SECI model (1995)

Socialization occurs when tacit knowledge is transferred to tacit knowledge in others. This process includes apprenticeship, mentoring, observation, practice, and imitation. Externalization occurs when tacit knowledge is transferred into tangible form or explicit knowledge by means of metaphors, analogies, concepts, hypotheses, or models. In this process, tacit knowledge is written, taped, drawn to make it explicit or concrete in some way. Combination means the process from explicit knowledge to explicit knowledge. In this process, no new knowledge is created but a combination or representation of existing explicit knowledge. Furthermore, this model also assumes that explicit knowledge will be converted into tacit knowledge by means of the process of internalization.

Wiig (1993) believes that knowledge must be organized in order for it to be valuable. But how do we organize it? He argues that this depends on what use will be made of the knowledge and how knowledge is stored in our mind as a semantic network with multiple paths. Based on this assumption, Wiig suggests four dimensions to consider knowledge content in his model: ‘completeness’, ‘connectedness’, ‘congruency’, and ‘perspective & purpose’. ‘Completeness’ refers to the relevance of knowledge from a given source. ‘Connectedness’ addresses the relationship among different knowledge objects. ‘Congruence’ is employed to describe the knowledge base if all the facts, concepts, perspectives, values, judgments, and associative and relational links between the knowledge objects are consistent. ‘Perspective and purpose’ refers to people’s particular point of view or their specific purpose on which the knowledge is based.

He further defines three forms of knowledge: public knowledge, shared expertise, and personal knowledge. According to Wiig (1993), public knowledge is explicit, taught, and routinely shared knowledge that is generally available in the public domain. Shared expertise is proprietary knowledge exclusively held by workers and shared in their work or embedded in technology. Personal knowledge is the least accessible but most complete form of knowledge. Furthermore, he divides knowledge into four types: factual, conceptual, expectational and methodological. Finally, Wiig outlines the basis of his KM model: a KM matrix including the three forms and the four types of knowledge (See table 2-2).

Table 2-2: The Wiig KM Matrix (Wiig, 1993)

Knowledge	Factual	Conceptual	Expectational	Methodological
Public	measure reading	stability balance	When supply > demand, price drops	Look for temperatures outside norm
Shared	forecast analysis	Market is hot	A little water in the mix is ok	Check for past failures
Personal	'right' texture, colour	Company track record	Hunch that the analyst is wrong	What is the recent trend?

A similar category of knowledge can also be found in Boisot's (1998) KM model, which emphasizes the differences between data, information, and knowledge. He presents a key concept of 'information good', and classifies knowledge into abstract or concrete; codified or uncodified, diffused or undiffused. Thus, in his I-Space model, Boisot developed a 3-dementional cube: abstract Vs concrete; diffused Vs undiffused; codified Vs uncodified.

Another major category of KM models is socially constructed models. Demerest's (1997) model could serve as a typical example. Demerest's model is an adaptation of Clark & Staunton's research (1989, in Demerest 1997). As shown in figure 2-2, this model assumes that the social construction of knowledge is the start point, with the solid arrows showing the primary flow direction. After that, constructed knowledge is embodied within the organization through a social exchange process. The following process is referred to as ‘knowledge dissemination’ which occurs throughout the organization. Finally, the knowledge will be used. The attractive point in this model mainly resides in the plain arrows which show the recursive flows. It is this recursive flow that demonstrates that the ‘use’ of knowledge becomes the central part in the model, implying the social construction of knowledge within organizations. As stated by McAdam & McCreedy (1999), these types of model partly represent the perspective from organizational learning or the learning organization.

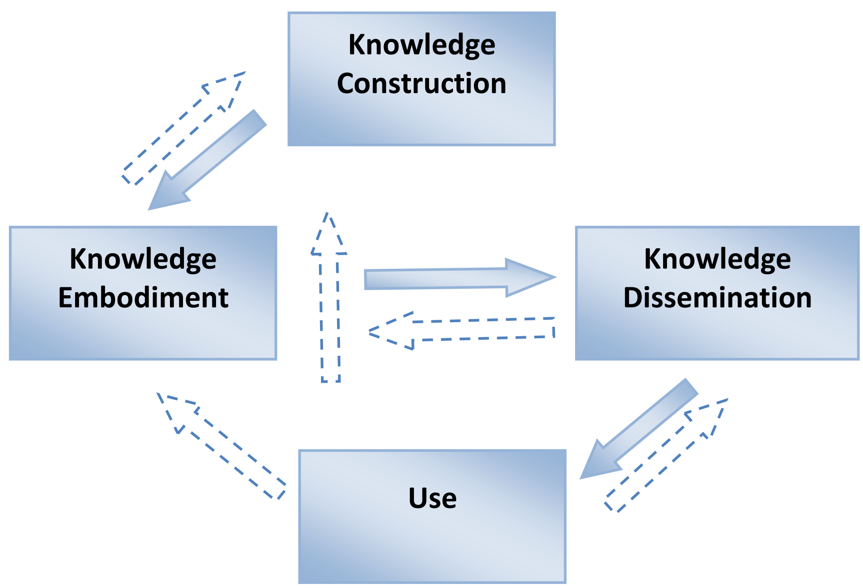


Figure 2-2: Demerest’s knowledge management model (Demerest, 1997)

2-4 Knowledge Management Cycles

As stated by King, Chang, and Haney (2008), life cycle models provide a useful way to organize one's thinking about KM. The life cycle model describes major phases or steps involved in KM. Based on different perspectives, the KM cycles are various. For example: Wiig's (1993) 4-stage KM cycle ('build, hold, pool, and use knowledge'); Meyer and Zacks' (1996) 5-stage model (acquisition, refinement, store/retrieve, distribution, presentation); Davenport and Prusak's (1998) 3-stage model ('generate, codify, and transfer'); McElroy's (2003) new KM model, and so on.

According to Wiig (1993), any successful organization presents two basic conditions: business and customers, and resources. Another more important condition is the organizational ability to act, while knowledge is the key force that determines this ability. To act intelligently, we must attain relevant and quality knowledge and apply them. Based on this, Wiig (1993) developed four major steps in his KM cycle: building knowledge, holding knowledge, pooling knowledge, and applying knowledge. 'Building knowledge' refers to learning from personal experience, intelligence sources, media, books etc., and formal education and training. Building knowledge consists of five main activities: obtain, analyze, reconstruct, codify, and organize knowledge. The second step is 'holding knowledge', which refers to remembering or accumulating knowledge in people or in some tangible forms like books. 'Knowledge pooling' includes coordinating, accessing, and retrieving knowledge by means of a knowledge base system or a brainstorm among a group of people, and the 'use of knowledge' is about the application of knowledge for work objects.

After addressing the shortcomings of the earlier KM, which is ‘techno-centric’ (McElroy, 2003, p3), McElroy developed his new generation KM, and outlined his knowledge life cycle. McElroy’s knowledge life cycle consists of two major sides: ‘knowledge production’ and ‘knowledge integration’. Within ‘knowledge production’, which he refers to as demand-side, there are five main activities: information acquisition, individual and group learning, knowledge claim formulation, codified knowledge claim, and knowledge claim evaluation. After knowledge being claimed and evaluated, it becomes organizational knowledge. Then the second side of the life cycle starts: ‘knowledge integration’, which he refers to as supply-side. Within this part, knowledge will be integrated by means of broadcasting, searching, teaching, and sharing in organizations, and finally forms a ‘distributed organizational knowledge base’.

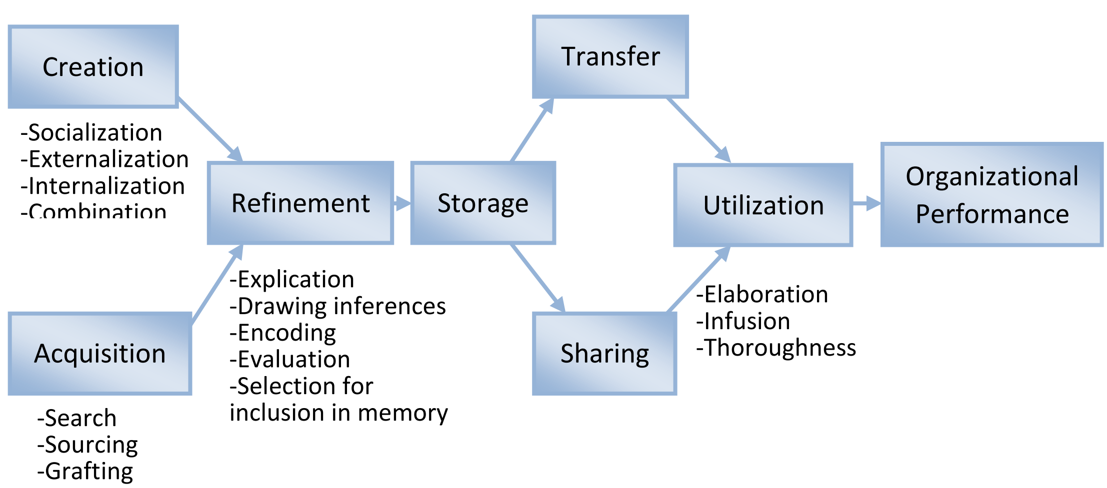


Figure 2-3: KM cycle model (King et al, 2008)

Although a lack of consensus exists among these KM cycles, they all regard knowledge in organizations as a valuable strategic asset and attempt to employ information and communication technologies to capture and leverage the knowledge to gain competitive advantage for the organization. In other words, the differences between these KM cycles are not really that great. After reviewing the life cycle models in the KM literature, King, Chang & Haney (2008) synthesized them and developed their own model to present a generic view of most previous cycle models (Figure 2-3), although, as stated by the authors, this model is meant to be illustrative and not necessarily definitional. As we can see from Figure 2-3, after knowledge has been created or acquired, it is refined and stored, then transferred or shared to those who need it. Once it is utilized, organizational performance is improved.

2-5 Knowledge Management Strategies

While this chapter has generally reviewed KM development, models, and cycles, it should now be apparent that there are different ways or approaches to managing knowledge in organizations. Thus there are different types of knowledge management strategies for organizations to adopt. This section is going to briefly review the work in knowledge management strategies.

Hansen et al. (1999) proposed two different types of KM strategy: codification and personalization. The codification strategy is based on the assumption that the codified knowledge is very important for a company to gain competitive advantages. So the core part of the KM in the company is the reuse of codified knowledge. As a result, the codified strategy is mainly concerned with the searchable repositories which can store and retrieve codified knowledge in the company. With such a KM strategy, the relevant knowledge process is thus to transfer knowledge from people to documents. On the other hand, the personalization strategy is based on the assumption that the worker's key knowledge is tacit and that it is difficult to codify, which implies that the competitive advantages of a company is only derived from the knowledge creation process, and the provision of innovative productions. With such a KM strategy, the company should aim to improve social processes that facilitate the face-to-face sharing of the tacit knowledge between people.

The main characteristic of Hansen et al.'s (1999) work on KM strategy is its connection to human resource management (HRM). With different KM strategies, the implications in HRM are different. The codification strategy will mainly motivate and reward people to codify their knowledge, and will stress the training in and the development of the IT skills of people. By contrast, the personalization strategy will mainly encourage and reward people to share their knowledge with others, and will emphasize the development of inter-personal skills.

Michael Earl (2001) developed another taxonomy of KM strategies which includes seven specific schools of knowledge management. He grouped them into three categories: technocratic, economic, and behavioural approaches. The technocratic approach, namely IT-based approach, includes systems school, cartographic school, and engineering school. The systems school mainly stresses the codification of knowledge into a database and the reuse of the knowledge as an organizational resource that require certain technological support, especially so-called knowledge-based systems. The cartographic school mainly focuses on knowledge mapping and the creation of knowledge directories. Again, technology plays an important role within this school to identify the knowledge and expertise that exists in the organization. The third technocratic approach to KM, the engineering school, is an extension of business process reengineering. IT systems are used with this approach to provide contextual knowledge or operational processes and procedures.

The second category, the economic approach, has only one specific KM strategy: commercial school. With this approach, organizations are trying to maximize returns by capitalizing their knowledge in the form of patents, trademarks, copyrights, and so on.

The final category of KM strategy, behavioural approach, emphasises people management practices and processes, which include the organizational, spatial, and strategic schools. The organizational school mainly focuses on organizational structures, networks, and communities of practices to facilitate knowledge sharing or exchange. The spatial school is mainly concerned with the creation of physical or virtual spaces to bring people together, providing opportunities for them to share knowledge and exchange ideas. The strategic school emphasises the formulation of strategies by a wide range of mechanisms, such as business plans or communication programmes, to raise the consciousness about value-creating possibilities from the knowledge management process.

In addition to the above works, there are many other researches on KM strategies. Murray (2000) suggested eight KM approaches which are similar to the seven schools by Earl (2001): the intellectual capital, knowledge as individual skills, philosophical, technological, strategic, process, the teams and knowledge agents approaches, and the combination of the approaches.

Mentzas (2001) identified two broad approaches for KM: the product approach and the process approach. These different strategies may be displayed for comparison in Table 2-3 below.

Table 2-3: KM Strategies

Authors	Year	KM strategy
Hansen et al.	1999	➢ Codification approach ➢ Personalization approach
Murray	2000	➢ The intellectual capital ➢ Knowledge as individual skills ➢ Philosophical ➢ Technological ➢ Strategic ➢ Process ➢ The teams and knowledge agents approaches ➢ The combination of the approaches
Earl	2001	➢ Technocratic approach (IT-based approach): ◆ Systems school ◆ Cartographic school ◆ Engineering school ➢ Economic approach: ◆ Commercial school ➢ Behavioural approach: ◆ Organizational school ◆ Spatial school ◆ Strategic school
Mentzas	2001	➢ The product approach ➢ The process approach

2-6 Knowledge in Knowledge Management

An overview of KM above has shown the complexity of the area. This is mainly due to the different understandings of knowledge itself, which affect our attitude to KM. So, what is knowledge in KM research? What is organizational knowledge in KM? The following sections will address these issues by reviewing the different understandings of knowledge in current KM literature, which is actually based on different philosophical perspectives.

2-6-1 Epistemologies of Knowledge in KM literature

As argued by Levinson (2007), there is no universal definition of KM, just as there is no agreement as to what constitutes knowledge in the first place. Defining knowledge is difficult, as it incorporates many intangibles such as experience, intuition, judgement, skill and lessons learned, which have the potential to improve actions (Henczel, 2001). According to Nickols (2000), when we use the word "knowledge", we seem to mean three things. First, knowledge is a state of knowing, which means to be acquainted or familiar with, to be aware of, to recognize or apprehend facts, methods, principles, techniques and so on. Second, knowledge is "the capacity for action", an understanding or grasp of facts, methods, principles and techniques sufficient to apply them in the course of making things happen. Third, knowledge is a body of knowledge that has been articulated and captured in the form of books, papers, formulas, procedure manuals, computer code and other media.

In the contemporary literature on knowledge management, knowledge has been described by different authors in different ways. Behind the different perspectives, there are different epistemological assumptions or philosophies, which directly determine what is being studied in KM. This research will not give one single definition of what knowledge is, but will reflect on the nature of knowledge in KM, namely the epistemologies of knowledge, by reviewing the contemporary debates on this topic in the literatures. As defined by Hislop:

> ***Epistemology is the "Philosophy addressing the nature of knowledge. Concerned with questions such as: is knowledge objective and measurable? Can knowledge be acquired or is it experienced? What is regarded as valid knowledge, and why" (Hislop, 2009, p16)***

These debates on the nature of knowledge can be traced back to previous centuries. To review the historical and philosophical literature is beyond the purpose of this research.

Cook and Brown (2002) pointed out that knowledge has become a prominent theme in existing organizational literature, and the distinctions between individual and organizational knowledge, tacit and explicit knowledge, have been much discussed. From an epistemological perspective, however, these four forms of knowledge have actually no differences in their basic assumptions. They all treat knowledge as something people possess. According to Cook and Brown (2002), the assumption behind this kind perspective about knowledge is 'the epistemology of possession'. In addition to this traditional epistemology of knowledge, they proposed another parallel 'epistemology of practice', arguing that "there is more epistemic work being done in what we know how to do than can be accounted for solely in terms of the knowledge we possess" (Cook & Brown, 2002, p53).

Burrell and Morgan (1979, in Schultze & Stabell, 2004) proposed a four-paradigm framework to categorize social and organizational science according to different epistemological assumptions about the nature of knowledge, i.e., positivism, interpretivism, radical structuralism, and radical humanism. Based on Burrell and Morgan's framework, Schultze and Stabell (2004) explore the different epistemological assumptions about knowledge in KM research. Their research starts from two primary questions '*what is knowledge?*' and '*when is knowledge?* '. According to them, the latter question is to open an inquiry into the emergent nature of 'knowledge' in situated practice, which puts 'knowledge' in a 'web of usability and action'. This thus connects 'knowledge' to activities and structures. As Cook and Brown (1999) proposed, when-questions imply an epistemology of practice, while what-questions reflect an epistemology of possession. Furthermore, the distinction between these two questions also implies a construction of the world in terms of 'dualism' and 'duality'. Dualism refers to 'either/or' thinking, i.e., mutually exclusive opposites. In contrast, duality applies 'both/and' thinking, which considers opposing forces that act simultaneously on the same phenomenon. Based on this, Schultze and Stabell (2004) suggested a dualism-and-duality epistemology dimension for knowledge existing in KM literature. According to them, dualism provides the theoretical foundation for classification, taxonomies, and contingency theory, and thus knowledge is seen as an object. Duality, however, tends to result in a dialectic yet integrative strategy, and is normally associated with pragmatism and theories of practice.

Empson (2001) concluded that there were two broad alternative perspectives to knowledge, one of which is viewing knowledge as an asset, and the other is thinking of knowledge in terms of knowing as a process. Obviously, the former perspective is based on the assumption that knowledge is an objectively definable commodity. Thus the goal is to identify useful knowledge and manage it effectively within the organization. The perspective which sees knowledge as a process is based on the assumption that knowledge is a social construct, thus knowledge cannot be managed as an objective reality but instead should only be maintained in social situations. The differences between these two perspectives are shown in table 2-4 below.

Table 2-4: Alternative perspectives on knowledge in organizations (Empson, 2001)

	Knowledge as an asset	Knowing as a process
Purpose of research	Normative To identify valuable knowledge and to develop effective mechanisms for managing that knowledge within organizations	Descriptive To understand how knowledge is created, articulated, disseminated, and legitimated within organizations
Disciplinary foundations	Economics	Sociology
Underlying paradigm	Functionalist	Interpretive
Epistemological assumptions	Knowledge as an objectively definable commodity	Knowledge as a social construct
Models of knowledge transmission	Exchanges of knowledge among individuals are governed by an implicit internal market within organizations	Knowledge is disseminated and legitimated within organizations through an ongoing process of interaction among individuals
Main levels of analysis	Organization and its knowledge base	Individual in social context

Similar categories of epistemology of knowledge can also be found in other research in the KM area, such as knowledge as theory versus knowledge as practice (Werr and Stjernberg, 2003); knowledge as truth versus knowledge as socially constructed (Demerest, 1997). Hislop

(2009) examined these epistemologies of knowledge and divided them into two distinctive groups: objectivist and practice-based perspectives.

These different epistemologies of knowledge in the KM area actually demonstrate a general agreement among scholars. As shown in table 2-5, the left side and right side of terms can be separately placed into two groups. Although different terms are used by different authors and have different theoretical origins, the implications of each group are quite similar. The terms given by Hislop (2009) will be adopted in this research, namely the objectivist perspective and the practice-based perspective, to represent the two major kinds of epistemologies of knowledge in the KM literature.

Table 2-5: Competing Epistemologies

Authors	**Epistemology of knowledge**		
Hislop (2009)	Objectivist perspective	Vs	Practice-based perspective
Schultz and Stabell (2004)	Epistemology of dualism	Vs	Epistemology of duality
Werr and Stjernberg (2003)	Knowledge as theory	Vs	Knowledge as practice
Cook and Brown (2002)	Epistemology of possession	Vs	Epistemology of practice
Empson (2001)	Knowledge as an asset	Vs	Knowledge as a process
Demerest (1997)	Knowledge as truth	Vs	Knowledge as socially constructed

2-6-1-1 The objectivist perspective on knowledge

From an objectivist perspective, knowledge is viewed as an entity or object, which is not only possessed by people, but also exists outside people in a number of forms, such as documents, databases and other technologies. This kind of perspective is actually rooted in the philosophy of positivism, which argues that it is possible to develop knowledge and understanding free from individual subjectivity. In other words, the social world can be studied scientifically.

As reviewed in the previous chapter, knowledge-based theory, developed from resource-based theory, regards knowledge as a valuable resource for organizations to gain competitive advantage. Thus it is natural for them to take an objective perspective on knowledge, regarding knowledge as an asset in the organization, and even considering capitalizing the knowledge as a commodity, which is called ‘intelligent capital’ (Sveiby and Risling, 1986; Brooking, 1997; Roos, et al., 1997; and Edvinsson,1997). According to them, the knowledge in organizations should be objective, and can be quantified and measured. This early perspective on KM seems somewhat simple and mechanistic (McAdam & McCreedy, 1999)

As another mainstream perspective in KM, Nonaka and Takeuchi (1995) adopted Polanyi’s division of knowledge, tacit and explicit knowledge, and developed their SECI model. It is not difficult to understand that the term, explicit knowledge, implies the same as objective knowledge mentioned above, which could be separated from individuals and be codified into documentations, databases, or any other tangible forms. Tacit knowledge, however, refers to knowledge that resides in people’s mind, which is personal and inexpressible. Compared to the perspective of ‘intelligent capital’, Nonaka and Takeuchi give more attention to tacit knowledge rather than explicit knowledge. They recognize the social nature of knowledge and suggest that organizations should build a 'Ba' for staff to externalize tacit knowledge into explicit knowledge, and to internalize explicit knowledge into tacit knowledge. Nonaka and Takeuchi thus focus on the conversion among these different types of knowledge. However this idea is still a kind of objectivist perspective, as it apparently regards knowledge as something, and divides knowledge into two pure and separate types, tacit and explicit, rather than two extremes of a spectrum.

This objectivist perspective of knowledge, which classifies knowledge into different types, can also be found in many works in the KM literature, such as Wiig (1993) and Boisot (1998) mentioned previously. In addition, Marshall and Reason (1993, in McAdam 2000), based on the social paradigm, classified knowledge into five forms: prepositional knowledge, theoretical knowledge, practical knowledge, experiential knowledge, and presentational knowledge. Garud and Nayyar (1994) proposed that there are three dimensions of knowledge: simple versus complex; independent versus systemic; explicit versus tacit. De Long and Fahey (2000) concluded that there are three distinct types of knowledge: human knowledge, social knowledge, and structured knowledge.

2-6-1-2 Practice-based perspective on knowledge

Compared to the objectivist perspective, a practice-based perspective on knowledge does not regard knowledge as an object or entity which can be codified. Instead, this perspective stresses the embeddedness of knowledge in work activities or practices. According to Hislop (2009), a practice-based perspective on knowledge is based on the assumption that human activities include not only a physical element, but also a cognitive element. Furthermore, these two aspects of human activity are inseparable.

According to Orlikowski (2002), ‘knowing’ is inseparable from another human activity, namely, doing. In this view, ‘knowing’ is a holistic process including not only the mind but also the body. Thinking and doing are fused in human knowledgeable practices. Therefore, all activities including the development and utilisation of knowledge are somehow knowledgeable, and knowledge is embedded in human practices or activities.

Schultze and Stabell (2004) distinguish this practice-based perspective from an objectivist perspective by a pair of logic: ‘either/or’ and ‘both/and’. According to them, in an objectivist perspective, the ‘either/or’ logic tends to result in categorising knowledge into different types which are independent of each other, while in a practice-based perspective, a ‘both/and’ logic will normally regard different types of knowledge as representing different aspects of knowledge that are not necessarily separate, but inseparable and mutually defined in fact. Taking the distinction between tacit and explicit knowledge as an example, in a practice-based perspective, both tacit and explicit are dimensions of knowledge. All knowledge has these two elements and there is no fully explicit knowledge. As Polanyi suggested (in Hislop, 2009), strictly explicit knowledge, such as spoken words, formulae or graphs, will be meaningless if deprived of their tacit co-efficients. Based on this argument, Polanyi’s idea about tacit and explicit knowledge has been misused by Nonaka and many other researchers, who hold an either/or logic, and see these two types of knowledge separately.

Another characteristic of the practice-based perspective on knowledge is the relationship between knowledge and people. According to practice-based perspective, knowledge is developed by people when they conduct activities and gain experiences. So knowledge is embodied and resides in the head of those who developed or constructed it. Thus there is no fully explicit knowledge within practice-based perspective; all knowledge or knowing is personal, and cannot be disembodied from people. This is quite different from the objectivist perspective, which regards knowledge as an object that can be acquired, coded, and stored somewhere else from people.

A good example of the practice-based perspective on knowledge in the KM literature is the concept of ‘community of practice (CoP)’ by Lave and Wenger (1991). Compared to knowledge codified in databases and other repositories, knowledge is retained in a ‘living’ way by a ‘community of practice’ (Kakabadse, 2003). Hildreth and Kimble (2000) extended CoP research further into an international and a virtual environment. The notion of the CoP realizes the complexity of knowledge creation and the apprenticeship model, where knowledge is transferred through situated learning in the community. It thus stresses practice and related communities in the workplace, in which lots of functions with respect to the creation, accumulation, and diffusion of knowledge in an organization are fulfilled.

2-6-2 Data, information, and knowledge

The above discussion has shown us two different, or even opposite, perspectives on knowledge in the KM area. Another very common perspective about knowledge is the cognitive perspective which distinguishes knowledge from data and information.

Johannessen et al. (2002) argue that knowledge is created within social systems. Hence, social systems and social facts should be the point of departure in increasing our understanding of knowledge. Bunge (1996) states that social systems are composed of people and their artefacts, and facts are states of or changes in concrete things. According to Johannessen et al. (2002), social facts are an ontological reality, where their counterpart is an epistemological construction. There exists a distinction between social facts and the constructs used to describe them. Therefore, “science is the study of facts, not data. The analysis of data is just a remedy to encroach upon facts” (Johannessen et al., 2002, p1100). Based on this understanding, Johannessen et al. (2002, p1100) define data as “systematizing and structuring of facts, given a code”. Also, they emphasize that:

> ***“the point here is not that the code is known for the recipient of data, but the existence of a code as such (without it, systematizing and structuring is not possible)” (Johannessen et al., 2002, p1105).***

Based on the above understanding of code, Johannessen et al. (2002) argue that it is only when these data about facts are systematized and structured, and when the code is understood, that we create information about these social facts. That is, when we create distinctions between data, understand the code representing the data, systematize and structure the data, then information has been created. Thus, information is the description of social facts. However, the relationship between the description and what is described is not a simple process. Watzlawick et al. (1967) used the notion of ‘first and second order reality’ to describe this process.

Compared to information, knowledge is the product of the individual mind (Searle 1996). Johannessen et al. (2002) point out that knowledge is dynamic and changes as a function of new systematizing and structuring of information. If a person, with the help of information, is able to develop conceptual systems for a part of the environment (or about himself) acting as guidance, this person has developed knowledge (Johannessen et al, 2002). Knowledge is more personal and considered to be "internal in me" while information is considered to be "external and outside me" (Stankosky, 2006). Singh (2007) insists that knowledge is a cognitive state of mind, achieved with the coupling of understanding and cognition. She distinguishes information and knowledge simply, as follows: Information is acquired by being told, whereas knowledge can be acquired by thinking. Only when information is actively processed in the mind of an individual through a process of reflection, enlightenment, and learning, can it be called knowledge and have practical significance.

Referring to the previous discussion on objectivist and practice-based perspective on knowledge, the 'knowledge' stored somewhere outside people themselves is actually information or even data. As argued by Al-Hawamdeh (2003, p18), "Knowledge is knowledge till it resides in the minds of people; once it is outside the human mind, it is information". Taking a book as an example, whether or not the content of the book is knowledge does not solely depend on the book itself, but on the people who read it. If the person who reads the book knows nothing about the subject, then the book means nothing about knowledge, or information, or data. This could be easily understood by a question as well: if a person has the biggest number of books in the world, does it mean he is the most knowledgeable person? The answer is definitely no, as the person does not necessarily understand or really possess the so-called knowledge from the books. This example also reflects the inseparable attributes between knowledge and people, which has been suggested by the practice-based perspective on knowledge.

Based on this understanding, the explicit knowledge from an objectivist perspective is actually information here, whilst the knowledge is the same as it is from the practice-based perspective. Data, information and knowledge are together referring to the whole cognitive process concerning social facts but at different cognitive levels. The hierarchical relationship among data, information, and knowledge is normally described as figure 2-4.

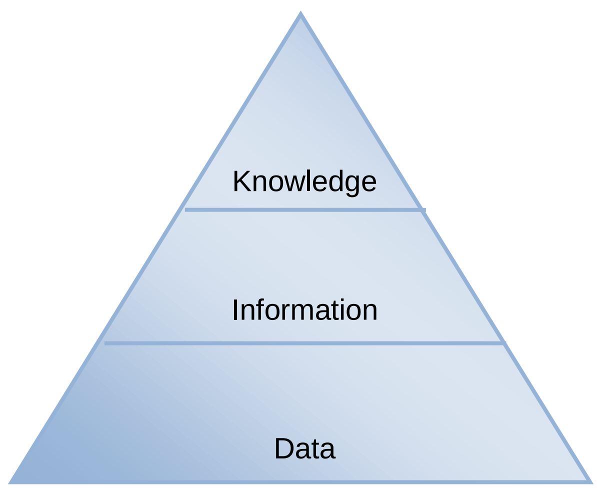


Figure 2-4: Data, information, and knowledge

2-6-3 Organizational knowledge

The previous sections have been discussing the concept of knowledge in KM at an individual level, namely individual knowledge. There is, however, much discussion in the literature about organizational knowledge, or group knowledge, or collective knowledge. Although the focus of this PhD research is individual knowledge, it is necessary to look briefly at the issues concerning knowledge at an organizational level, namely organizational knowledge, to provide a comprehensive understanding between the concepts of individual and organizational knowledge in KM.

As mentioned previously, the main organizational driver for knowledge management is to help organizations gain competitive advantage. The term ‘organizational knowledge’ employed in the literature is actually a general term which simply means all knowledge that belongs to, or can be leveraged by, organizations. It might refer to knowledge possessed by staff, or documentation recorded in organizations. In this sense, organizational knowledge includes individual knowledge. Until the development of ‘Intelligent Capital’, organizational knowledge had different meanings in contrast with individual knowledge. The terms organizational knowledge and individual knowledge together become a dimension of knowledge in an organization and refer to knowledge at different levels. Organizational knowledge mainly refers to the knowledge that is retrieved, transmitted, stored, and shared at organizational level. However, this is an objectivist perspective on knowledge, as discussed previously, within which organizational knowledge is not different from information. As pointed out by Tsoukas & Vladimirou (2002, p974), within this kind of perspective, organizational knowledge is seen as “synonymous with information, especially digital information”.

Whilst Polanyi (1966) argues that all knowing is personal knowing, we may ask how knowledge becomes organizational. Nonaka’s work, the dynamic theory of organizational knowledge creation (Nonaka, 1994), was trying to answer it. According to Nonaka (1994), knowledge is created by individuals through conversion between tacit and explicit, which encompasses four processes: socialization, externalization, combination, and internalization. Each of the four processes of conversion can create new knowledge. Without individuals, organizations cannot create knowledge. Therefore, organizational knowledge creation is actually a process that “organizationally amplifies the knowledge created by individuals and crystallizes it as a part of the knowledge network of the organization” (Nonaka, 1994, p17). Based on this, organizational knowledge will be created when all four processes of conversion are organizationally managed and become a continual cycle. As stated by Nonaka (1994, p20):

> ***“Organizational creation can be viewed as an upward spiral process, starting at the individual level moving up to the collective (group) level, and then to the organizational level, sometimes reaching out to the inter-organizational level.”***

According to Nonaka, knowledge in organizations can be divided into a two by two dimensional matrix: organizational vs. individual, and tacit vs. explicit. Thus there are four types of knowledge in organizations: organizational tacit knowledge, organizational explicit knowledge, individual tacit knowledge, and individual explicit knowledge.

However, Tsoukas & Vladimirou (2002) link individual knowledge and organizational knowledge to human action by arguing that knowledge is essentially related to human action. According to them,

> ***"Knowledge is the individual capability to draw distinctions, within a domain of action, based on an appreciation of context or theory, or both" (Tsoukas & Vladimirou, 2002, p87)***

Similar to this understanding of individual knowledge, organizational knowledge has been regarded as

> ***"the capability members of an organization have developed to draw distinctions in the process of carrying out their work, in particular concrete contexts, by enacting sets of generalizations whose application depends on historically evolved collective understandings" (Tsoukas & Vladimirou, 2002, p87)***

In order to understand organizational knowledge, Tsoukas & Vladimirou (2002) argue that a theory of organization is required. According to them, the different roles in organizations are normally explicitly defined. It is these institutionalized roles (actually the rules of action) that guides behaviours, or makes the recurring behaviours generated in organizations. Organizations can be regarded as a theory, "a particular set of concepts and the propositions expressing the relationship between concepts" (Tsoukas & Vladimirou, 2002, p92). The application of rules and the justification underlying them are actually collectively shared meanings agreed in organizations. In this sense, "organizational knowledge is the set of collective understandings embedded in a firm" (Tsoukas & Vladimirou, 2002, p93). Thus, organizational knowledge exists in organizations as shared practices, work routines, perspectives, and assumptions. This kind of perspective can also be found from other researchers such as Cook and Brown (1999).

2-7 Chapter summary

This chapter provided an overview of knowledge management covering different definitions of KM, two main KM models, namely knowledge category models and socially constructed models; different KM cycles; and different KM strategies an organization may adopt. It has helped us understand the KM in practice and theory.

As different understandings of knowledge affect our attitude to KM, this chapter also discussed the different meanings of knowledge in the KM literature. Behind the different perspectives of knowledge, there are different epistemological assumptions which have been concluded as two major sides: the objective perspective and the practice-based perspective on knowledge. In the objective perspective, knowledge is regarded as an asset or something people possess, whilst in a practice-based perspective, knowledge is seen as a social construct and cannot be managed as an objective reality but instead should only be maintained in social situations. Another very common perspective on knowledge discussed in this chapter was the distinction between data, information, and knowledge. The hierarchical relationship between the data, information, and knowledge revealed our cognitive process concerning social facts at different cognitive levels. In this research, the practice-based perspective of knowledge was adopted, namely, knowledge cannot be disembodied from people and thus acquired, coded, and stored somewhere else. Based on the special nature of knowledge, how can knowledge be effectively transferred in an organizational environment? The next chapter attempts to answer this question by comparing knowledge sharing and knowledge seeking in KM.

___CHAPTER THREE ___

Knowledge Sharing Vs Knowledge Seeking

3-1 Introduction

Knowledge sharing has long been emphasized in the KM literature and in practice, assuming that both the individual and the organization can develop via sharing knowledge. However, knowledge sharing has its challenges: why should an individual share knowledge with others? Which is more important for an organization: existing knowledge or new knowledge? How knowledge should be 'transferred' in the organization: by pushing or pulling? This chapter will review the literature in the area of knowledge sharing with the goal of identifying the fundamental barriers to knowledge sharing. The special nature of knowledge will also be discussed. Based on this discussion, the researcher defines knowledge seeking as an individual learning process or a knowledge construction process, rather than merely finding out so-called knowledge from somewhere or somebody, as referred to in the literature with terms such as 'knowledge sourcing', 'knowledge acquisition', and even 'information seeking'. It is proposed that it is knowledge seeking, rather than knowledge sharing, that plays the crucial role in knowledge management.

3-2 Knowledge sharing in KM

Arguably, all knowledge is personal. How can we manage the knowledge effectively and leverage it for the benefit of the organization? What if the staff leave the organization, such as through retirement, redundancy, resignation? How can we extract knowledge from individuals? These types of question lead many KM researchers and practitioners to think of knowledge sharing in the first place, to encourage people who have knowledge of the work in the organization to share their knowledge with other members of the organization. Through knowledge sharing, it is argued that individual knowledge will be transferred among members of organizations and become organizational knowledge in the end. According to Yang & Wu (2008), if staff can share their individual knowledge, the organization and individuals can both develop. This is the basic argument in many KM perspectives, although different ways to share might be suggested (such as Nonaka's SECI model, Lave and Wenger's CoP, and so on).

Consequently, knowledge sharing becomes the starting point of knowledge management. It is one of the main goals of many KM initiatives to encourage and improve knowledge sharing within the organization. As stated by Wang and Noe (2010, p115), "knowledge sharing is the fundamental means through which employees can contribute to knowledge application, innovation and, ultimately, the competitive advantage of the organization". This leads to other questions: To what does knowledge sharing refer? What happens during the knowledge sharing process?

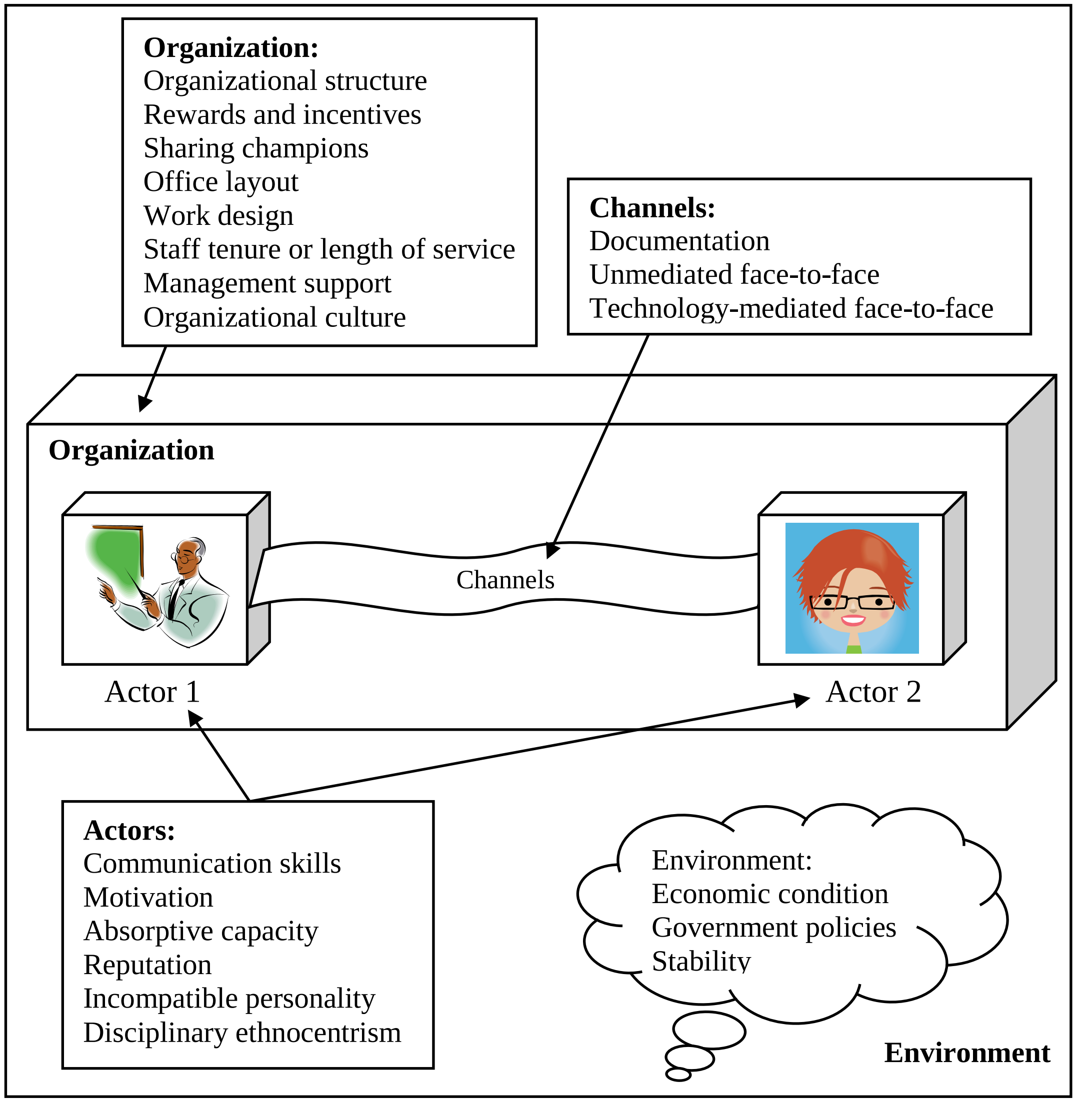


Figure 3-1: The actor framework (adapted from Lee & Al-Hawamdeh, 2002)

Lee and Al-Hawamdeh (2002, in Al-Hawamdeh, 2003) described a framework for the knowledge sharing process (see Figure 3-1) which is commonly used in the KM area. The knowledge sharing process is seen as a process taking place between two actors, for example Actor 1 and Actor 2. There are various sharing channels between them. For example, the channel might be a face-to-face conversation, or a one-to-many speech or presentation, or many-to-many team discussion. Furthermore, this process might employ technology for a lively communication, such as telephone, video conferences, internet; or it might use a document. Figure 3-1 also demonstrates the factors impacting knowledge sharing in organizations which arises from different parts of the process, such as those from the actors, from the channels, and from the organizational environment.

Much of the KM literature about knowledge sharing mainly addresses these factors impacting the knowledge sharing process, which derive from two major areas: the organizational context, and individual and interpersonal factors. Research addressing the latter mainly focus on staff's attitudes, behaviours, or individual personalities and dispositions on knowledge sharing (such as Judge and Bono, 2001; Cabrera et al. 2006; Lin, 2007); or motivational factors (such as Wasko & Faraj, 2000; Hew& Hara, 2007); or interpersonal relationships and social networks (such as Robinson, 1996; Abrams et al. 2003; Regans & McEvily, 2003; Cross & Cummings, 2004).

Knowledge sharing research addressing the organizational context mainly focus on management support (such as Cabrera et al., 2006; Lee et al., 2006; Kulkarni et al., 2006), rewards and incentives (such as Bock et al., 2005; Kankanhalli et al., 2005; Yao et al., 2007), organizational structure (such as Kubo et al., 2001; Jones, 2005; Kim & Lee, 2006), and organizational culture. There is general agreement that a supportive organizational culture should be created for knowledge sharing (Davenport & Prusak, 1998; Park et al., 2000). Many organizational cultural dimensions have been linked to successful knowledge sharing, among which trust has become the most popular one (Park et al., 2000; Kankanhalli, et al. 2005).

There has also been some research into multinational cultural issues around knowledge sharing (such as Ford & Chan, 2003; Lai & Graham, 2009).

3-3 Knowledge sharing dilemmas

Knowledge sharing has been widely regarded as the fundamental approach for knowledge management (Wang & Noe, 2010), and many studies focus on knowledge sharing motivation or knowledge contribution behaviours (e.g. Constant et al., 1994; Bock et al., 2005; Kankanhalli et al., 2005). Many organizations have invested huge time and money to develop knowledge management systems employing state-of-the-art technologies to facilitate the knowledge sharing activities. However, according to Babcock (2004), this investment has resulted in huge financial losses among Fortune 500 companies, at least $31.5 billion per year, due to a failure to share knowledge. It is also widely accepted that there are many barriers and problems with knowledge sharing, in addition to the factors discussed in the previous section. Bearing this in mind, it is reasonable to ask some fundamental questions around knowledge sharing: why should the individual share their knowledge? Is knowledge sharing the fundamental means of knowledge management? The following section will critically explore these knowledge sharing dilemmas.

3-3-1 Why should I share? The root of the barriers

Based on a resource-based perspective or knowledge-based perspective to organizations, knowledge is seen as an important strategic asset or resource in organizations. Where knowledge is viewed as a kind of resource for organizations, knowledge sharing has been frequently explained by economic theories. Since knowledge sharing takes place in organizations, and among people, it has also been explored via social or behavioural theories. Whatever perspectives or theories we follow, the barriers to knowledge sharing are fundamental and from the root. As argued by Pfeffer (1997), the most fundamental question in organizational studies is how we understand the causes of behaviour. So what could cause people to share their knowledge?

From an economic perspective, the primary motivation of behaviour is self-interest. Knowledge sharing is similar to other traditional economics of tangible resources, which can be explained by a cost-benefit analysis. Based on this perspective, the scarcity of knowledge decides its value. Those who own the scarce knowledge will have a great advantage within or among organizations. These people would seek great benefit from the receivers or the organizations since they might lose their advantage or their benefit might be damaged if they share their knowledge with others. Why should they share their scarce knowledge? Various exchange theories have been introduced to explain the knowledge sharing behaviours.

Christensen (2005) argues that knowledge sharing is an exchange process where the individuals offer something of value while receiving something of value. In other words, the motivation for sharing knowledge is actually with the expectation of receiving something in return, such as more knowledge, money, or gratitude. Different exchange models try to explain how and when the returns are made. Some assume that all economic exchanges like this rest on the schema of giving and returning the equivalence, for example, Fiske (1991), Ferrary (2003), Boer, Van Baalen, and Kumar (2004). Christensen (2005) proposes three kinds of exchanges in knowledge sharing, namely financial, organizational, and social exchange. In financial exchange, the knowledge sharer receives a return with monetary rewards. Organizational exchange refers to the return by promotions or other measures related to organizational identities. Social exchange is mainly based on informal exchange of personal commitment and relationships.

Similar to exchange theory, social dilemma theory has been introduced to explain the knowledge sharing dilemmas. Social dilemma theory argues the paradoxical situations between individuals and the public (Cabrera, 2002). In this perspective, the sharing of knowledge between individuals is seen as one of the processes underlying collective knowledge. This collective knowledge is seen as a kind of public good, or the commons. The collective knowledge, as a kind of shared property, is open to every individual. There is an apparent benefit in letting as many individuals as possible share with the collective knowledge. However, if every individual just took from the collective knowledge without contributing to it, the commons would be damaged until nobody was able to benefit from it. This is named the tragedy of the commons, as everybody tries to maximize individual payoff (Cabrera, 2002). As a consequence, collective damage will result. In other words, this is the paradox: individual rationality leads to collective irrationality (Kollock, 1998).

Since there is no restriction on access to the commons, namely the collective knowledge, individuals tend to enjoy the commons without contributing to it or exchanging with it. If you take from the commons without contributing or exchanging, you are enjoying the goods for free. Who does not like free things? It is a rational thought. However, if everyone acts like this rationally, nobody would cooperate, and eventually everybody will suffer this ‘tragedy of the commons’.

This takes us back to the starting point: how can we encourage or facilitate people to share their knowledge, as they cannot be forced to do so. The willingness of individuals becomes critical here. Another kind of perspective, focusing on the intentions of behaviour, has been introduced to analyse knowledge sharing: the theory of reasoned action (TRA). According to Fishbein and Ajzen (1975), an individual's behaviour is determined by their intention to action, whilst this intention is determined jointly by their attitudes towards, and the subjective norms regarding their behaviour. Based on this framework, Bock, Zmud, Kim, and Lee (2005) propose three motivational drivers influencing individual attitudes towards knowledge sharing, namely, (1) anticipated extrinsic rewards from an economic perspective, (2) anticipated reciprocal relationships and sense of self-worth from a social psychological perspective, and (3) fairness, innovativeness, and affiliation from a sociological perspective.

The above discussion has illustrated the fundamental barriers existing in knowledge sharing. However, most current research about knowledge sharing tends to regard it as a linear, one-way process, in which the knowledge flows from the sharer to the receiver. This SRMC model normally includes a sender, a receiver, the message, and the context. This kind of model is able to illustrate the flow of knowledge and that the knowledge has been transferred. It does not demonstrate the whole process of how knowledge is shared, since knowledge sharing is a kind of exchange. In other words, it is an interactive process. Both giving and receiving should take place in the knowledge sharing process. In actuality, it is difficult to request people to simply share their knowledge because we are asking people to do what they do not want to do. We can only to encourage, provide incentives, or facilitate the knowledge sharing behaviours or processes, since the barriers are fundamental.

3-3-2 Existing knowledge versus new knowledge

According to the perspective of knowledge sharing, individuals have knowledge in mind, and this knowledge should be shared and transferred in organizations (Yang & Wu, 2008; Wang & Noe, 2010). If knowledge cannot be effectively shared, then it is likely to fade away. Where face-to-face communication is not possible, we can rely on some technologies to capture this knowledge first. Then, we can find and utilize the knowledge later when we need it. Arguably, the sharing of existing knowledge within organizations will help them to effectively utilise available resources. This implies that 'knowledge sharing' is dealing with the existing knowledge in organizations. However, is the existing knowledge up to date, or has it been validated in a changing environment? Can the existing knowledge be utilized with a 'one size fits all' mentality? Will the people who receive the existing knowledge learn or create new knowledge? Can knowledge sharing alone help organizations gain or maintain their competitive advantages?

Knowledge sharing implies the transferring of some knowledge from one person to another (Al-Hawamdeh, 2003). This process results in the copying of knowledge, not the creation of new knowledge. However, as pointed out by Coulson-Thomas (2004, p88), "copying and sharing commodity knowledge is not the route to market leadership". New knowledge is increasingly important for organizations, as it is the source of competitive advantage (Porter, 1985; Conner, 1991; Halawi et al. 2005). Knowledge management, as a new management concept, helps organizations to create and leverage new knowledge to gain or maintain competitive advantage (Sveiby, 1986; Drucker, 1993). According to Coulson-Thomas (2004), KM should be an end-to-end process, from identifying knowledge requirements, to knowledge creation, sharing, and application, to enable innovation and deliver additional income streams. Most KM initiatives focus exclusively on the knowledge sharing part of the process, while knowledge creation and exploitation tend to be missing.

Knowledge creation, as a concept, was mainly introduced by Nonaka (1995). According to Nonaka (1995), in a knowledge creating company, knowledge is created through the interaction and intersection between tacit and explicit knowledge. This is a cyclical process in the form of a spiral and includes four steps: socialization, externalisation, internalisation, and combination. Although knowledge sharing, as a term, is not used in Nonaka's model, knowledge sharing activities have been stressed. For example, the socialisation phase and combination phase in the model actually refer to the sharing or tacit knowledge and explicit knowledge among colleagues respectively. According to Nonaka, it is such sharing of knowledge that makes knowledge creation become possible in organizations. In other words, knowledge sharing is a prerequisite of knowledge creation in organizations, and they are positively related.

This perspective has been questioned recently by Tatiana Andreeva (2009). According to Andreeva (2009), knowledge creation is usually expected to bring new knowledge or innovation compared to knowledge sharing which refers to copying or replication. To explore the relationships between knowledge sharing and knowledge creation, Andreeva (2009) conducted research in some knowledge-intensive companies in Russia. She found that individuals have preferences towards either new knowledge creation or existing knowledge sharing. Furthermore, a person cannot be inclined to both processes at the same time. The findings imply some contradictions between the knowledge sharing and knowledge creation processes. Thus the two processes are not positively related, as Nonaka proposed.

The differences between knowledge sharing and knowledge creating illustrate the different emphases on existing knowledge or new knowledge to be found within organizations. Although there are different viewpoints about these two knowledge related processes (i.e. positively related or not), they can be regarded as two independent processes both of which should be taken into account. When we are faced with a changing environment and today's modern society, new knowledge is crucial for gaining and maintaining competitive advantages, whilst sharing existing knowledge alone is apparently not enough.

3-3-3 Knowledge: pull versus push

The main aim of knowledge sharing is to encourage people to contribute their knowledge, to transfer knowledge from the sharer to the receiver, so that knowledge can be effectively utilized. The problem here is what makes this transfer process happen in the first place when knowledge is still in the knowledge sharer's mind. Is it the sharer who initiates the knowledge transfer process or the receiver? In other words, is it the sharer, who pushes the knowledge to the receiver, or a seeker, who pulls the knowledge to himself, triggering the knowledge transfer process? Actually, this question has leaded to two different approaches in knowledge management: knowledge push (or supply-driven) approaches and knowledge pull (or demand-driven) approaches (Scarbrough et al., 1998).

According to Alavi and Leidner's (2001), knowledge push approaches aim to increase the knowledge flow in organizations by capturing, codifying, and transmitting knowledge. This is actually another form of knowledge sharing: The sharer's knowledge is captured and codified in some format and then is transferred to the seeker. In contrast, knowledge pull approaches are concerned with the problems of engaging employees in the process of searching for and applying knowledge. The knowledge sharing perspective or knowledge push approaches tend to dominate the KM literatures. Much of them give emphasis to the employment of information technology to enhance knowledge capture, knowledge codification, and knowledge storing, especially the creation of knowledge databases, such as expert systems, or knowledge repositories.

Although knowledge is really important for organizations and has been regarded as a kind of asset, it is not really an object or entity like other assets. It is necessary to understand how knowledge is created or gained by people. As discussed in Chapter Four, knowledge is special and personal. It is embodied and resides in the heads of those who developed or constructed it. Thus, within practice-based perspective there is no fully explicit knowledge. All knowledge or knowing is personal, and cannot be disembodied from people. Knowledge is only developed by people themselves when they carry out activities and gain experiences. Within this perspective, there is no knowledge transfer process but instead a knowledge construction process or learning process. Bearing in mind the discussion about data, information, and knowledge, what is transferred is not knowledge but some form of data or information, which will help other people to learn or to construct knowledge that in turn belongs to themselves.

For instance, somebody shares his knowledge with you by giving you his notebook about solving some problems. However, you will never get that ‘knowledge’ in the notebook if you are not interested in it, or do not read it and learn from it. As the knowledge has been reduced to data or information when it was expressed or recorded (e.g. in the notebook) by the ‘sharer’, it is thus the ‘seeker’ who will construct the knowledge with the help of the data or information from the sharer or, even more, from others. Knowledge will not be ‘shared’ if the ‘seeker’ cannot or does not construct the knowledge by themselves. A similar situation in a classroom could serve as another example. The students are taught by the same teacher in the same way at the same time. However, the results could be quit varied, as there will be students of different abilities. In other words, the teacher is sharing his knowledge with the students in the same way, but the results of the knowledge sharing process will be different as a result of the different knowledge seekers (among some other factors). Therefore, in the knowledge sharing or transfer process, the key aspect is not the ‘sharer’ but the ‘seeker’ side as the nature of knowledge. The next question concerns how the ‘seeker’ starts to learn. Or, in other words, what triggers us to learn? The answer could also help us to understand what initiate the knowledge sharing or transferring process.

According to Larson (1991), as a kind of informal and incidental learning, workplace learning occurs most often when the learner is faced with an event or situation that is recognised as disconcerting or non-routine. As argued by Cseh, Marsick and Watkins (1999), a new life experience tends to provide a challenge, a problem to be resolved, informal and incidental learning normally begins with such kind trigger. This is to say that in a workplace, learning is normally triggered by a challenge or problem to be resolved. Then we tend to learn to solve the problem or meet the challenge. This kind of perspective is also similar to action learning. According to Revans (1982), learning is initiated when people question their own direct experience. In Revans' (1982) learning equation, learning is programmed knowledge plus questioning insight, which implies that individuals in the workplace learn from experience through reflection and action, usually to solve problems they meet at work. In other words, learning occurs in the process of finding solutions to problems in the workplace.

Based on this, the problem we meet is actually the trigger of a learning process. The person who encounters a problem or a challenge will then become a seeker to actively learn, or 'pull' the knowledge (if we see knowledge as an object) to solve the problem. At this time, if anyone would like to share his knowledge with the seeker, then a so-called knowledge sharing or transferring process will be started. Apparently, it is not the knowledge sharer, but the opposite side, the knowledge seeker, who is trying to seek or pull knowledge to solve the problem. It is the pull not the push that makes learning or knowledge transferring take place. This implies that simply 'pushing' the 'knowledge' to others does not mean a knowledge transfer process will happen. Knowledge sharing can only provide help to others who want to learn or actively seek. Only when we are actively 'pulling', namely learning, can the knowledge be shared with or transferred to us.

3-4 The emergence of knowledge seeking

The above discussion about the dilemmas of knowledge sharing has demonstrated three fundamental problems: firstly, people are reluctant to share their knowledge with others without any exchange or rewards. Secondly, knowledge sharing is actually focusing on existing knowledge, while the utilization of existing knowledge is not enough in today's changing environment. We need new knowledge to gain or maintain competitive advantages. Thirdly, knowledge sharing is trying to push knowledge to others, whilst the pull by the seeker is the key aspect in the 'knowledge transfer' process. Due to the nature of knowledge, to meet a problem at work is the trigger for people to actively learn or construct their own knowledge, namely, to actively pull knowledge.

The PhD researcher firmly stands on this point that it is knowledge seeking rather than knowledge sharing that makes knowledge transfer or knowledge creation possible. This implies that it is not enough just to emphasize knowledge sharing and give emphasis to the knowledge sharer or push side. We should pay more attention to the opposite side of knowledge sharing, to those who actively seek solutions for the problems or challenges they meet at work, namely 'knowledge seeking'. Thus, there is an apparent need to explore how knowledge seeking will take place, and what factors might be involved in this process.

Firstly, what is knowledge seeking? Some researchers have studied in this area, but it seems that there are different understandings of knowledge seeking. Various notions have been employed, each with a different focus, referring to the knowledge seeking process, such as knowledge acquisition, knowledge sourcing, knowledge creation and, even, information seeking. In some literatures they are even used in an overlapping way. For example, in Motwani's (2006) study knowledge acquisition, information acquisition, information gathering, and knowledge creation are used alternately referring to the same thing. Before a definition is given to knowledge seeking in this research, the related literature will be briefly reviewed.

3-4-1 Existing research related to knowledge seeking

There is not much research using the notion of knowledge seeking. Knowledge seeking mainly refers to behaviours associated with seeking knowledge from Electronic Knowledge Repositories (EKR). Apparently, these studies regard knowledge as an object or entity, and individuals can find it out when they need it. Kankanhalli, Tan, and Wei (2001) found that people can use the EKR as both contributors and seekers of knowledge. Prior researches mainly focused on the contributors, exploring how people share their knowledge to the system. So they conducted their research to formulate and test a theoretical model explaining an individual's knowledge seeking behaviour with the EKR. Three major factors were considered in their study, namely technology related factors (such as the quality of output, the use of EKR system), organization related factors (such as policies and procedures in the organization, and the reward systems), and task factors (such as task interdependence, knowledge tacitness). After analysis of the data collected from more than 100 knowledge workers, they concluded that technology characteristics and organizational characteristics have direct impact on knowledge seeking behaviour, while task characteristics play a moderating role in the knowledge seeking process.

Kankanhalli and Tan et al (2005) repost on further research to test the model relating potential antecedents to EKR usage. Their study reveals that perceived output quality, resource availability, task tacitness and interdependence, and incentives affect EKR usage for knowledge seeking. Following Kankanhalli, Tan, and Wei's (2001) study, Sanjeev and Gee-Woo (2005) employed the Decomposed Theory of Planned Behaviour and Technology Acceptance Model to investigate the factors influencing an individual's knowledge seeking behaviour in EKR, providing an understanding of the underlying psychological processes in knowledge seeking. Many factors have been identified as influential in knowledge seeking behaviour in EKR: perceived usefulness, seeking effort, trust, and information asymmetry.

To encourage knowledge transfer in organizations, collaboration has been regarded as very important in knowledge management. Bock, Kankanhalli, and Sharma (2006) conducted research to explore how collaborative norms in an organization influence knowledge seeking with regard to the EKR. According to them, collaborative norms positively influence individuals' knowledge seeking from EKR.

There are some other notions used in KM literature similar to the meaning of knowledge seeking, for example, knowledge creation and knowledge sourcing. Nonaka and Takeuchi (1995) argue that knowledge will be created when tacit and explicit knowledge is interconverted in organizations. Gray and Meister (2004, 2005) use 'knowledge sourcing' to describe the activities in organizations in which individuals intentionally access each other's expertise, experience, insights, and opinions. According to them, knowledge sourcing methods refers to the specific mechanism by which an individual accesses another's knowledge, including those recently proposed in the KM literature (such as knowledge repositories) and well-established organizational practices (such as meetings). They classified three different types of knowledge sourcing, and argue that each method may support multiple forms of knowledge sourcing: dyadic knowledge sourcing, published knowledge sourcing, and group knowledge sourcing.

Gray and Meister (2004) propose a general model of knowledge sourcing, which includes contextual, dispositional antecedents, and learning outcomes. They attempted to identify knowledge sourcing effectiveness based on these three aspects. They concluded, from a survey, that knowledge sourcing explains a significant proportion of individuals' learning outcomes. In 2005, they made further efforts to explore whether different classes of knowledge sourcing methods produced different kinds of performance outcomes (Gray and Meister, 2005). This study revealed that different classes of methods were not as interchangeable as the KM literature might suggest. At the same time, they found that technology-based methods are not inherently superior or inferior to traditional methods.

Knowledge acquisition is another term related to knowledge seeking. Beveren (2002), for example, presented a model to describe the knowledge acquisition process. According to him, knowledge is different from information, and knowledge can only be created from the processing of information in our brain. Thus, the knowledge acquisition process is divided into two separate processes: outside and inside our brains. When we acquire knowledge, we acquire information through the sensors at the first stage. Then this information is processed in the brain by using prior knowledge, during which new knowledge may be acquired or created. Apparently, this perspective on knowledge acquisition is based on information processing learning theory, which regards information processing as a black box, a psychological process in the brain.

Zhou (2004) related tacit knowledge acquisition to the study of intelligence. He argues that practical intelligence concerns problem solving, problem finding and knowledge acquisition. Assimakopoulos and Yan (2006) explored how Chinese software engineers acquired codified and tacit knowledge in their daily work. They argue that knowledge acquisition refers to a series of activities, such as seeking advice, learning to solve technical problems and so on. Some sources of knowledge seeking have been identified in their study: for example, technical books and online searching, local community of practice, and personal networks.

Knowledge acquisition also appears in the computing science literatures in the field of knowledge-based systems or expert systems. Brewster, Ciravegna and Wilks (2001, p1) argue that, “for knowledge to be managed it must first of all be captured or acquired in some useful form, e.g. stored in an ontology”. According to Gebus and Leiviska (2007), knowledge acquisition implies how we extract knowledge from experts and represent it in a knowledge-based system, and this activity is normally carried out by a knowledge engineer. From a computing science perspective, the research in knowledge acquisition focuses on how to employ or develop new techniques to extract knowledge, how to define the ontology in the database, and how to automate the knowledge acquisition process to reduce time or cost, and so on.

3-4-2 What is knowledge seeking in KM

3-4-2-1 Knowledge seeking is a learning process

To define knowledge seeking, the meaning of knowledge needs to be clarified. Many learning theories have been developed to explain how knowledge is created, from the behaviourist theories in the early stages, like Pavlov, which emphasizes the principle of ‘stimulus-response’, to the cognitive theories, like Bandura and Weiner, which focus on the internal processes of the mind and view the learner as an information processer. Developed from cognitive theory, the constructivist view of learning argues that individuals construct knowledge through an interpretative interaction with the social world they experience. Knowledge is actively received either through the senses or by way of communication (Von Glasersfield, 1989). According to Vygotskian's (1978) cognitive development perspective, the construction of knowledge is mediated by the socio-cultural context of its acquisition. Billett (1995, p21) argues that "appropriation involves an interpretative appraisal and construction of knowledge by individuals, rather than being a faithful representation of externally-derived stimuli". Knowledge is a subjective concept and is always contextual. Jakubik (2007) argues that knowledge cannot exist in a vacuum and is not static, but is instead a dynamic concept created in social interactions. Therefore the cognising subject actively constructs knowledge.

As a kind of adult learning, learning in the workplace is different from student learning. Conlon (2004) pointed out that much of what we learn in the workplace occurs during informal practice, namely, informal learning or incident learning. In Chapter Four, workplace-learning theories were reviewed, such as experiential learning, action learning, and situated learning. Apart from this, the most common way to describe knowledge is to distinguish it from data and information. Compared to information, knowledge is the product of the individual mind and it is subjective in the ontological sense (Searle 1996). As Stankosky (2006) argues, knowledge is 'people based' rather than 'bits based' and is about a 'capacity to take action'. Knowledge is personal and is thought to be 'internal in me', while information is thought to be 'external and outside me' (Stankosky, 2006, p50).

If a person, with the help of information, is able to develop conceptual systems for the part of the environment acting as guidance, this person has developed knowledge (Johannessen et al, 2002). Maturana & Varela (1992) point out that all knowing depends on the structure of the knower and, without the existence of the knower, knowledge does not exist. “Knowledge is knowledge till it resides in the minds of people; once it is outside the human mind, it is information” (Al-Hawamdeh, 2003 in Singh 2007, p170). Only when information is actively processed in the mind of an individual through reflection, enlightenment, learning, or doing, can it be called knowledge. In other words, the known and knower are indivisible. This kind of perspective can also be found in many other literatures (Wilson, 2000; Jakubik, 2007; Hassell, 2007).

Most KM perspectives focus on the integration and coordination of the individual’s knowledge. They acknowledge the differences between information and knowledge and give emphasis to the social and cognitive attributes of knowledge. However, they view knowledge as a noun and try to capture and store it outside the human mind and share it in organizations. Given knowledge is a cognitive process in a human’s mind, how can it be codified, transferred and shared by technologies? The concepts of information and knowledge appear to be used in a confusing or overlapping manner in much of the research in the KM field. As stated by Wilson (2000, p50), “knowledge is knowable to the knower…it cannot be transmitted…only information about the knowledge can be recorded and accessed by another person”. Knowledge is different from information in that knowledge is always embodied and is always the experience of some individuals in a society (Hassell, 2007).

Even in Nonaka and Takeuchi's SECI model, the application of the dualistic distinction of knowledge, tacit and explicit, is overly simplistic. As stated by Mooradian (2005), the tacit/explicit distinction of knowledge is 'structural or relational'. They cannot convert from one kind to another. Both kinds of knowledge actually support each other and 'allow them to be acts of knowing' (Mooradian, 2005). Given the definition of tacit knowledge, how can we externalise it easily? If it is created through doing, learning, and experience, how can tacit knowledge be 'converted' from another kind: explicit knowledge? Furthermore, knowledge is no longer real knowledge and is reduced to information for others, once it is divorced from one's mind. Even so-called explicit knowledge needs a cognitive learning process to 'convert' from information into knowledge.

As Churchman (1971) argues, knowledge resides in the user and not in the collection of information. This implies that having more information does not necessarily lead to enhanced knowledge creation. Simply delivering or 'pushing' information to a user's desktop may not be an effective approach to the management of knowledge, due to the lack of the user's attention that is required for processing this information and constructing it into knowledge. Knowledge is created or constructed on the basis of 'pull' by individuals. This clearly tells us that KM is essentially a deeply social process, and that knowledge seeking (demand pull), compared to knowledge sharing (supply push), is the core and foundation of knowledge management. Without this vital link in the cycle of knowledge management, how can we put KM approaches into practice? Those traditional KM concepts that mainly emphasise information technologies and knowledge sharing are thus too neat and simple to survive in the workplace.

3-4-2-2 Defining knowledge seeking

Based on this new understanding of knowledge and learning theories discussed above, this researcher regards knowledge seeking within organizations as:

> ***A learning process, or a process of constructing knowledge, which results in the improvement of the seeker's knowledge structure to solve problems or satisfy some goal.***

This definition is placing emphasis on the cognitive process of knowledge construction within individuals, through information seeking, sense making, and learning by doing, by experiences, or by problem solving (see Figure 3-2). It is a learning process, which focuses on not only the meaning of the material (so-called data/information/knowledge) for the seekers in certain situational or organizational contexts, but also how they solve problems they meet, and what knowledge they gain or create eventually in their mind through this process. Without such a process, knowledge will not be constructed by individuals, and knowledge management will not demonstrate any difference to information management.

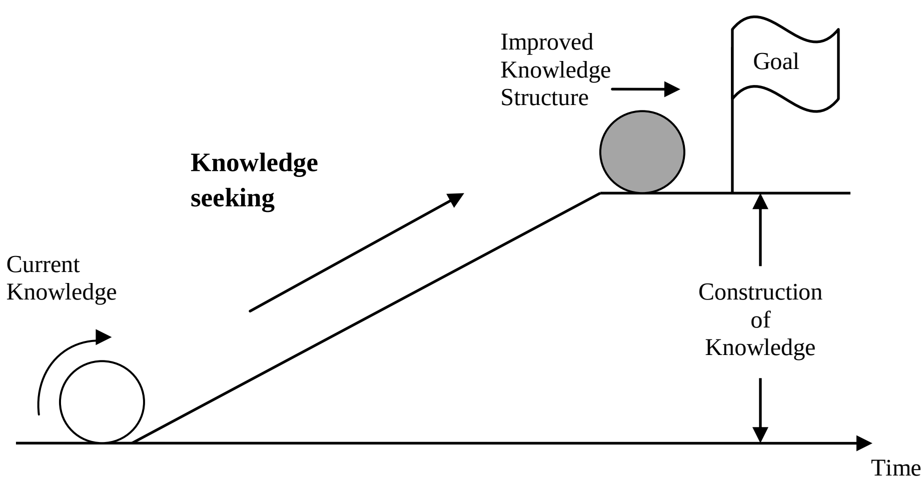


Figure 3-2: Knowledge construction in a workplace

Furthermore, the concept of ‘knowledge seeking’ here is different from knowledge sourcing, knowledge acquisition, information seeking, and knowledge seeking as found in literature. According to Wilson (2000), information seeking behaviour is the purposive seeking for information as a consequence of a need to satisfy some goal. This implies giving emphasis to what kind material or fodder the seekers are looking for in order to satisfy their goal. The concepts of knowledge sourcing, knowledge acquisition and knowledge seeking refer to finding out ‘knowledge’ from somewhere. As stated by King, Chung & Haney (2008), knowledge acquisition involves the search for, recognition of, and assimilation of potentially valuable knowledge, often from outside the organization. This viewpoint tends to regard knowledge as something existing somewhere and means to seek or find it out, which is no different to information seeking as described above.

3-4-2-3 Knowledge seeking in the KM cycle

Based on this discussion of the nature of knowledge and learning, we can look back at the KM cycle described in Figure 2-3 in Chapter Two. It seems reasonable to consider ‘Refinement’ in this model as an activity that selects, codifies or reduces knowledge to information. ‘Storage’ is a database, a book, or some documents to store this information, and ‘Knowledge Transfer’ is actually ‘Information Transfer’. Knowledge ‘Utilization’ is only undertaken by the people who have received helpful information and have constructed it into their own knowledge structure by a learning process, that is, an act of ‘knowing’. Furthermore, people who utilize their knowledge will still be learning through the ‘Utilization’ phase and will gain knowledge from it. Thus, this researcher has adapted the KM cycle in Figure 2-3and proposes a new version, shown in Figure 3-3.

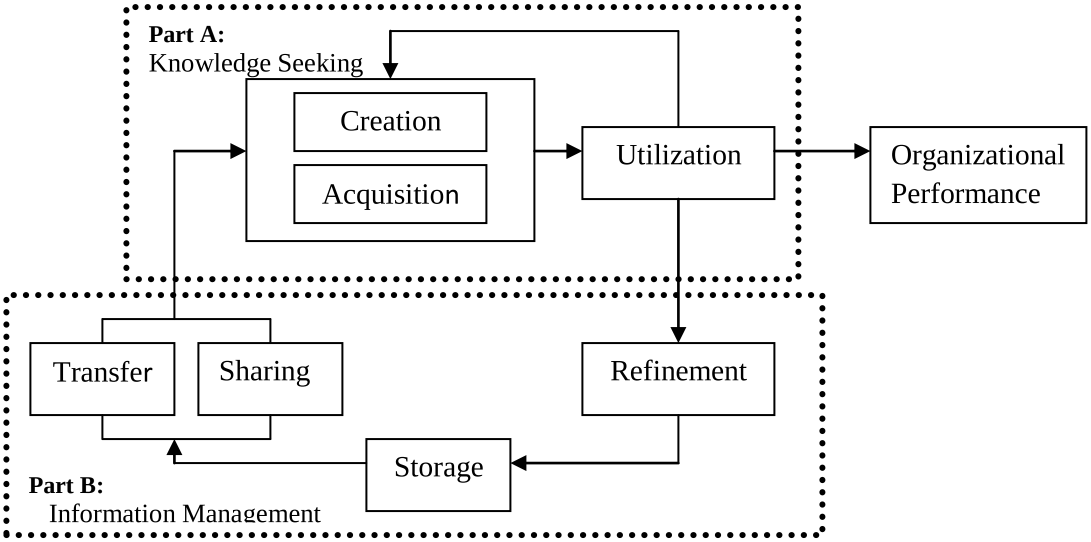


Figure 3-3: An adapted KM cycle

In order to allow a comparison, all the activities or phases listed have retained their previous names as in the original model (Figure 2-3). Much the same can be said of this new model at this stage in its development: to be illustrative and not necessarily definitional. As shown in Figure 3-3, the part B, with its emphasis on knowledge sharing, is actually information management. Knowledge is regarded as a noun and people in organizations are assumed to be actively seeking and learning knowledge once they are provided with this shared ‘knowledge’. The cognitive process of knowledge construction or the conversion of information into knowledge (as shown in Figure 3-2) tends to be neglected in many KM cycles. Part A in Figure 3-3 is illustrating such a cognitive learning process, although the activities or how people gain knowledge in this part still needs further examination. This researcher strongly argues that this process of knowledge construction (Part A in Figure 3-3) is the crucial part of the management of knowledge in organizations and names it ‘knowledge seeking’, in contrast with the popular concept of ‘knowledge sharing’.

3-5 Chapter Summary

This chapter began with a review of the concepts and importance of knowledge sharing in existing KM literature. This was followed by a deep analysis of the challenges knowledge sharing might be facing with in KM practices: why would an individual share their knowledge? What knowledge should an organization rely on to gain competitive advantage, existing knowledge or new knowledge? What initiates the knowledge transfer process in an organization, pull or push? These challenges leaded to a discussion of the emergence of knowledge seeking. Considering the special nature of knowledge, the current researcher firmly stands on the point that it is knowledge seeking rather than knowledge sharing, among others, that makes knowledge transfer or knowledge creation possible.

The existing literature related to knowledge seeking has also been reviewed, which includes different notions, such as knowledge acquisition, knowledge sourcing, knowledge creation, and the definition of knowledge seeking. However, these studies regards knowledge as an object or entity, and individuals can find it out from somewhere when they need it, which apparently simplified the knowledge seeking process. Based on the review of literature, the current PhD researcher defined knowledge seeking in this study as a learning process which results in the improvement of the seeker's knowledge structure to solve problems or satisfy some goal. Based on this new definition of knowledge seeking, the knowledge management cycle has been adapted, in which two different parts were identified, namely knowledge seeking and information management. From this sense, information management became a supportive part to the knowledge seeking process which will eventually will improve organizational performance.

The next chapter will go further to explore what are involved in knowledge seeking process in a workplace by review related literature, namely, information seeking, problem solving, and learning in a workplace.

___CHAPTER FOUR___

Information Seeking, Problem Solving and Learning in the Workplace

4-1 Introduction

It is proposed that information seeking, problem solving, and learning in a workplace are involved in the knowledge seeking process. These three aspects will thus be reviewed in this chapter. Many studies have been conducted to explore information seeking behaviours, especially since 1980s. In this chapter, some major information seeking models will be reviewed. After that, the chapter will provide an overview of problem solving research, followed by a discussion of problem solving models that will help us understand the process of how a problem solver find the resolution to the problem. How people gain knowledge in the workplace will be explored in this chapter as well. This includes a review of the major learning theories in general, and then research concerning learning in a workplace, namely informal learning, organizational learning, experiential learning, action learning, and situated learning. At the end, this chapter summarizes the literature reviewed in this chapter to bring out the underlying links between the major themes, namely the links between experiential learning, problem solving, and information seeking. This leads to a preliminary framework for knowledge seeking in this research. In addition, the a priori codes for the knowledge seeking process will be identified for later exploration in this thesis.

4-2 An overview of information seeking behaviour research

The research into information seeking behaviour has existed for many years. According to Wilson (2000, p49), information seeking behaviour is “the purposive seeking for information as a consequence of a need to satisfy some goal”. The earliest research in this area can be traced back to the 1940s which mainly focused on the users of libraries. For example, The Library Survey (McDiarmid, 1940, in Wilson, 2000) described many studies concerning library use. Since then, attention has been paid to the use of information sources and systems, document use, exploring how information sources can be more useful to us and how we can make better use of these sources. Wilson (2000) stated that much of the earlier information behaviour research was mainly about library use and focused on scientists and their use of information. However, since the 1980s, most researchers have turned their focus on the user by a ‘person-centred approach’ and developed information seeking models (Kuhlthau, 1993; Ellis, 1989; Wilson, 1984; Dervin, 1983). And recently, a theoretical information behaviour framework based on cognitive science, social science, complexity theory (Mosindi & Sice, 2011). These models try to display the whole process of information seeking.

There is much research that focuses on different aspects of information seeking: information seeking behaviour and information system design (Johnstone et al, 2004; Fidel & Pejtersen, 2004); information seeking behaviour in certain industry or people (Wathen & Harris, 2006;

Gross, 2001); information seeking behaviour in image retrieval (Conniss et al, 2000); information seeking behaviour on internet or other electronic environment (Enochsson, 2005; Siatri, 1998; Marchionini, 1995); information seeking and learning (Borgatti & Cross, 2003); culture and information seeking (Komlodi & Carlin, 2004). Furthermore, many researchers have explored factors that influence human information seeking behaviour, such as personality (Sonnenwald & Iivonen, 1999; Heinstrom, 2000; 2003), cognitive style (Rouse, 1984; Ford et al, 2002; Fabritius, 1998), image and worldview (Wilson, 1984), social capital (Johnson, 2004), gender (Enochsson, 2005), and contexts and contests (Gaslikova, 1999; Choo, 2007).

4-3 Models of information seeking behaviours

According to Spink and Cole (2004), human information behaviour relates to the study of human behaviours in relation to information seeking, foraging, retrieving, organizing and use. Wilson (1999) argues that models of information behaviour are kinds of statement, seek to describe, in the form of diagrams, an information activity, the causes and consequences of that activity, or the relationships among stages in information seeking behaviour. This section will review some major models, namely Wilson's models of information behaviour (Wilson, 1981; 1999), Ellis's behaviour framework (1989), Kuhlthau's stage process model (1993), and Foster's non-linear model (Foster, 2005)

4-3-1 Wilson's information seeking behaviour model

In order to outline the various areas covered by information behaviour, Wilson (1981) devised a model (Figure 4-1) to display the whole process of information behaviour. In this model, Wilson suggested that when an 'information need' was perceived or identified by an information user, he tended to start his information seeking behaviour to satisfy this need. He would make demands upon formal of informal information sources or services. The formal sources refer to information systems such as libraries, on-line services and so on. The informal sources refer to seeking information from other people rather than the formal systems in organizations. Both kinds of information sources or services might have two different results: success or failure to find useful information. If successful, the information would be used by the user to satisfy his information need, which had been identified before. If the information gained was not able to satisfy, or fully satisfy, the user's need, then the user had to reiterate this seeking process.

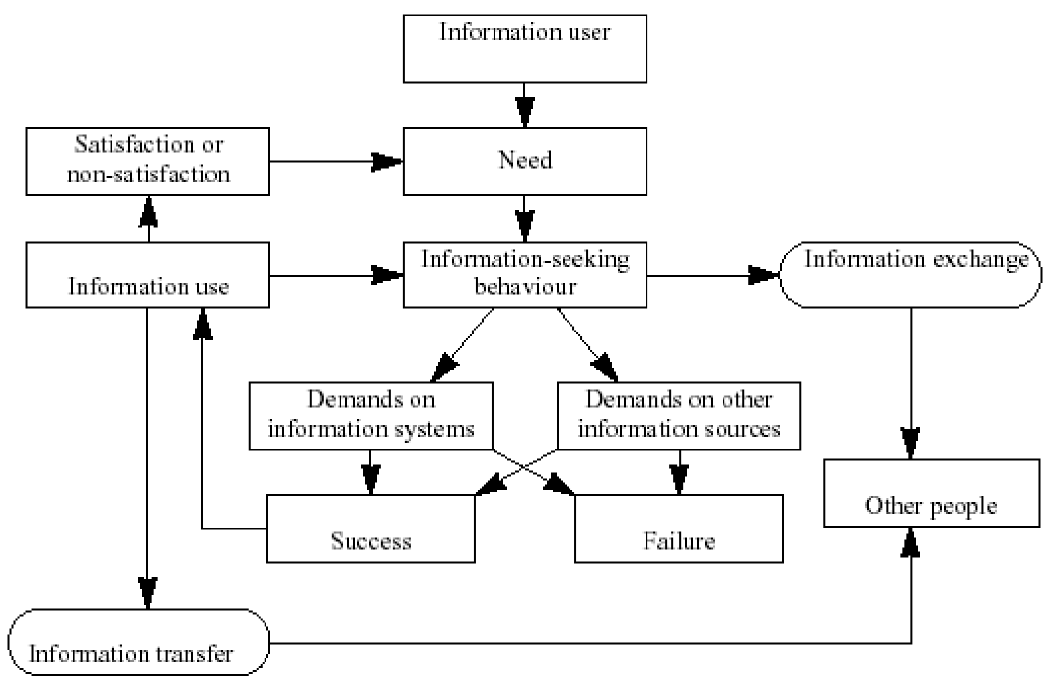


Figure 4-1: Wilson's model of information behaviour (Wilson, 1981)

However, this kind of model just provides us with a map of this area. As criticized by Wilson himself (1999), this model does not analyse the whole information seeking process in detail, nor does it list out the causative or impeditive factors in such a seeking behaviour. In view of this, Wilson (1999) devised another information-seeking model (Figure 4-2). According to Wilson (1999), this evolved model is based on two propositions. Firstly, information need is not a primary need but a secondary need arising from another more basic kind of need. Based on a psychological perspective, these basic needs could be physiological, cognitive, or affective, while the context of these needs might be personal (the person him- or herself), social (the demands from the person's role in work or life), or environmental (political, economic, technological, etc.). Secondly, there are different kinds of barriers that appear for the information enquirer during the process of discovering information to satisfy a need. Again, these barriers could be personal, social (or role-related), or environmental.

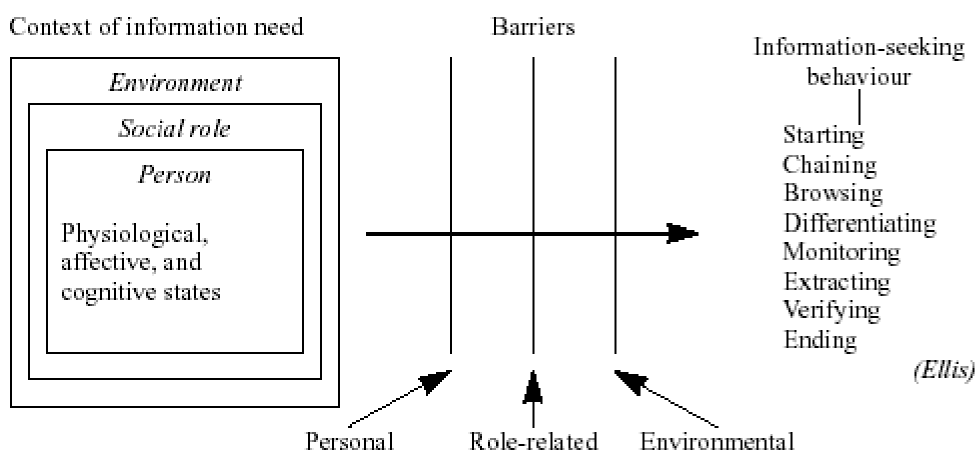


Figure 4-2: Wilson's model of information-seeking behaviour (Wilson, 1999)

This model is intended to clearly describe how information needs arise and what may prevent the actual search for information, and many context factors, such as a person's environment, social roles and individual characteristics.

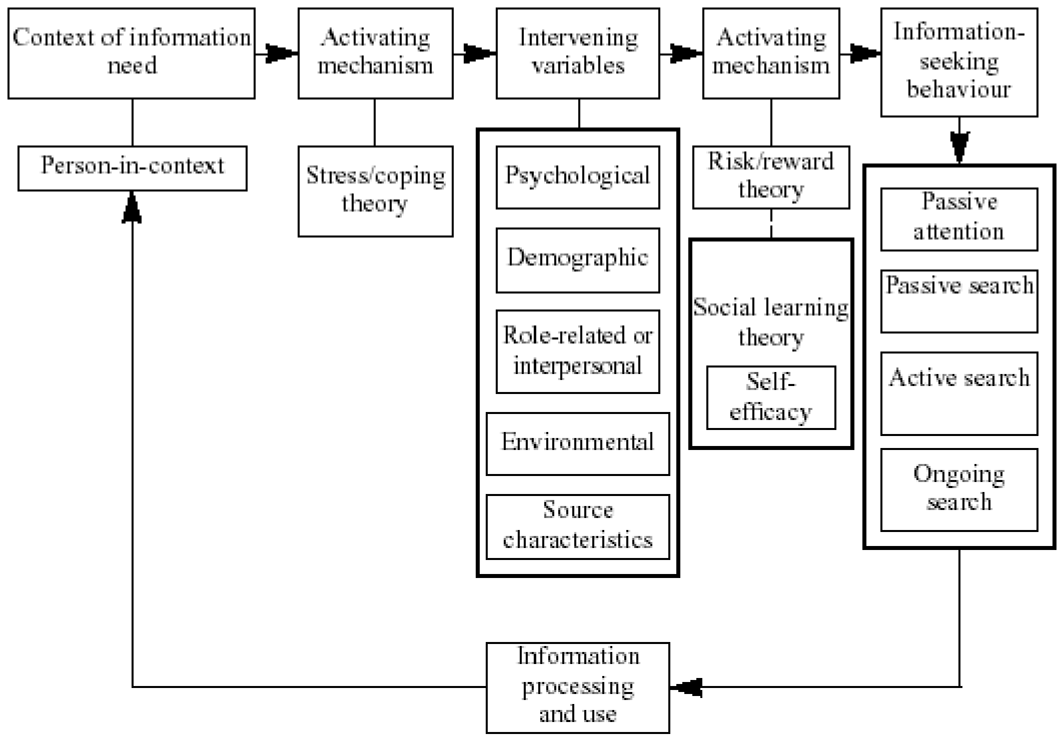


Figure 4-3: Wilson's model of information behaviour (1999)

By 1996, Wilson had expanded his model into a new version (Figure 4-3), based on research from different fields including information science, psychology, innovation, and decision making. The 'barriers' in the previous model have been replaced by 'intervening variables', which suggest that the impact of these variables may not only be preventive as a barrier, but also be supportive as enablers. At the same time, the information seeking behaviour has been expanded as well, consisting of four types, namely, passive attention, passive search, active search, and ongoing search. Furthermore, ‘information processing and use’ becomes a necessary part in the model to form a feedback loop, which supports the identification of information needs.

All in all, this new model remains one of macro-behaviour, which identifies possible intervening variables and the possible forms of action the seeker may take. This expansion made it a very popular source of hypotheses for further research.

4-3-2 Ellis’ information seeking model

Ellis (1989) adopted a behavioural approach to elaborate different behaviours involved in information seeking. Based on empirical research, the information seeking patterns of academic social scientists were identified. Rather than listing out stages in the process as most models did, Ellis concluded that there were six characteristics of information seeking patterns: starting, chaining, browsing, differentiating, monitoring, and extracting. According to him, these characteristics constitute the principal generic features of the patterns and together provide a behavioural model for information retrieval system design. These features of information seeking behaviour were then tested by Ellis’s subsequent studies. In 1993, based on grounded theory, interviews were conducted by Ellis, Cox, and Hall (1993) to analyse the above key features among a group of research physicists and research chemists. The results in this research were compared with those of the social scientists in Ellis (1989). However, no fundamental differences were identified in information seeking behaviour between the two groups of scientists; instead, there was a little modification to the previous research: apart from the above six features, two more features were added, namely verifying and ending.

In 1997, further research was conducted by Ellis and Haugan (1997) to explore the role of information and information seeking in an international oil and gas company. The information seeking patterns of engineers and research scientists were analysed and explored. Eight categories were identified on this occasion to describe the information seeking patterns: *surveying, chaining, monitoring, browsing, distinguishing, filtering, extracting, and ending*. According to Ellis and Haugan (1997), *surveying* is usually initiated to generate ideas for new projects in the beginning of a project's life cycle. The scientists or engineers tend to make use of surveying to approach the new or unfamiliar subject field for a pre-study prior to the project plan. Normally, researchers carry out surveying through personal contacts or computerised literatures. Colleagues in their own unit are usually seen as the starting point. They tend to ask the people whom they think are knowledgeable in a particular area to get some guidelines and information about it.

Chaining refers to the connection or chain between the different sources. It is performed mainly by following references in some sources, obtained through surveying normally, to other references from other sources. According to Ellis and Haugan (1997), the decision to stop following a chain of references is based on the time available, or in the case of the chaining of personal contacts, it mainly depends on the knowledge the people possess, and their willingness to give information.

Monitoring refers to activities involved in maintaining awareness of developments and technologies in a field for keeping up-to date. Both formal and informal channels are employed here (Ellis & Haugan, 1997). The formal channel refers to the use of scientific journals or conference proceedings. The informal channel refers to personal contacts

Browsing is another important part of the information seeking process. It resides not only in monitoring activities, but also in surveying activities by means of the scanning of journals and browsing of references and abstracts of printouts from retrospective literature searches (Ellis & Haugan, 1997). Browsing is used usually to scan a wide range of sources, both primary and secondary, to find something of particular interest.

Filtering is used in the information seeking process to make the information searched as relevant and precise as possible. It is normally fulfilled by the use of certain criteria or mechanisms when searching for information. However, according to Ellis and Haugan (1997), there is an apparent conflict in filtering activities, namely reducing the time for searching versus the risk of failing to obtain important information. A wider range of searching for information normally demands more time spent in the information seeking.

Extracting is characterised by working through sources to locate material of interest (Ellis & Haugan, 1997). It is used when the scientists, for example, are giving different kinds of presentation, such as a research report, review of the literature, a project summary, or an article for publication.

Ending activities refer to those involved in actually finishing the information seeking process. It normally happens at the end of a project by carrying out a small scale search targeted towards some unsolved questions. It is used to check if something has appeared in the last stage that may influence the project, or if there are some questions that must be clarified.

Ellis (1989) stated that the detailed interrelation or interaction of these features mainly depends on the particular circumstances of the person at a particular time. Thus, he did not draw a diagrammatic model to depict the interrelations of these features. Wilson (1999), however, evaluated the meaning of these features and suggested a diagrammatic presentation of them (see figure 4-4). As proposed by Wilson (1999), 'starting' obviously initiates a process and 'ending' must end it. So they must be the first and last step respectively. Furthermore, 'browsing', 'chaining', or 'monitoring' are search procedures; 'differentiating' is a filtering process; 'extracting' must come after the search procedures and filtering process. As shown in figure 4-4, the model becomes a stage process version of Ellis's behavioural framework.

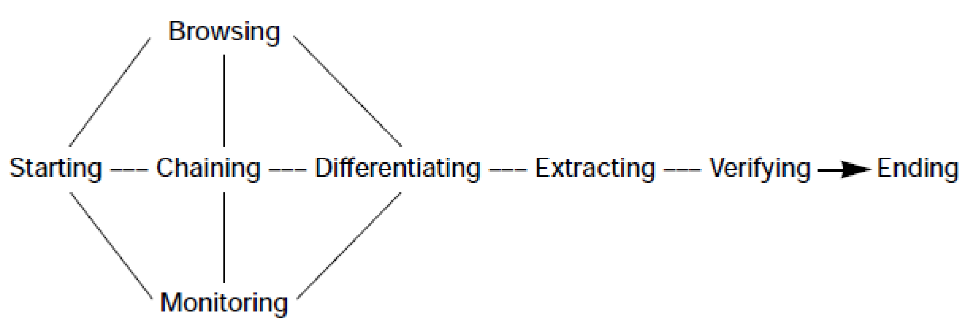


Figure 4-4: A stage process version of Ellis's behavioural framework (Wilson, 1999)

4-3-3 Kuhlthau's six stages of information search process

Information system design is mainly driven by a bibliographic paradigm, which emphasises collecting and classifying information for their retrieval. However, this traditional pattern of information provision is different from information users' natural process of information seeking. To bridge this gap, Kuhlthau (1991) attempted to explore the information search process from the user's perspective and proposed a new information search process model.

According to Kuhlthau (1991), the information search process is a constructive activity to find meaning from information. This process aims to extend a users' knowledge on a particular problem or topic. From a cognitive perspective, people actively construct their view by means of assimilating new information with what they know before. Based on a series of five studies conducted in field situations with actual library users, Kuhlthau (1991) developed a six-stage model of the information search process, including initiation, selection, exploration, formulation, collection, and presentation. Furthermore, three realms were identified in each stage of the process: the affective (feelings), the cognitive (thoughts), and the physical (actions). (See Table 4-1).

At the '*initiation*' stage, a person tends to be aware of the lack of knowledge and his task is recognizing a need for information. His thoughts mainly focus on contemplating the problem, or comprehending the task. Based on his existing knowledge or experiences, his actions will normally involve seeking background information to identify possible topics and approaches.

Table 4-1: Six-stage model of information search process (Kuhlthau, 1991)

Stages in ISP	Feelings Common to Each Stage	Thoughts Common to Each Stage	Actions Common to Each Stage	Appropriate Task According to Kuhlthau Model
1. Initiation	Uncertainty	General/ Vague	Seeking Background Information	Recognize
2. Selection	Optimism			Identify
3. Exploration	Confusion/ Frustration/ Doubt		Seeking Relevant Information	Investigate
4. Formulation	Clarity	Narrowed/ Clearer		Formulate
5. Collection	Sense of Direction/ Confidence	Increased Interest	Seeking Relevant or Focused Information	Gather
6. Presentation	Relief/ Satisfaction or Disappointment	Clearer or Focused		Complete

The '*Selection*' stage involves the identification & selection of the general topic to be investigated. The thoughts at this stage emphasise perspective topics compared to the assignment requirements, personal interest, and information available. The actions in this stage are mainly about conferring with others, or skimming and scanning for alternative topics.

'*Exploration*' involves exploring information in order to extend personal understanding. The major feelings at this stage are confusion, uncertainty, while the thoughts mainly centre on how to be sufficiently informed about the topic to form a focus. The actions at this stage include reading to locate information about and understand topics, relating new information found to existing knowledge.

At the '*Formulation*' stage, a focused perspective of the topic will be formed from the ideas in the information. So the thoughts in this stage include identifying and selecting ideas from the new information. The topic will thus become clearer and more personalized. As a result, feelings of confidence will be increased, with a sense of clarity at this stage.

When the user is able to acquire information effectively and efficiently from the information system, '*Collection*' will then occur in order to gather relevant information. The thoughts will concentrate on how to define, extend, and support the already personalized topic. The user who has got a clearer sense of direction will be able to specify the need for relevant and focused information at this stage. This will facilitate a comprehensive search of information from available resources.

In '*Presentation*', the search will be completed; the findings will be presented or be used. The users will then think of culminating the search based on their synthesis of the topic. If the information search has gone well, feelings will be a sense of satisfaction. If it has not gone well, the feelings will be a sense of disappointment.

As we can see, this six-stage model illustrates a user's experiences during the information search process, from the cause of the search, feelings, thoughts, actions during each stage, to the completion of the search. Along with the different information searching behaviour or activities in each stage, this model also shows us an implicit process of the gradual refinement of the problem area that users encounter.

4-3-4 Foster's non-linear model

According to Foster (2005), previous information seeking models, such as Ellis and Wilson's models, are normally linear processes which consist of stages and iterative activities. By exploring the information seeking behaviour among some inter-disciplinary researchers, he developed a new non-linear model of information seeking behaviour, which illustrates a dynamic and inter-relationships of behaviours, activities, and context. As stated by Foster (2005), this new model suggests a potential revision of some of the core ideas of information science by providing an alternative explanatory framework.

Foster's study was based on a sample of academic and postgraduate researchers in universities whose research topic was inter-disciplinary. According to him, interdisciplinarity includes individual research topics in which the primary knowledge domain is clearly focused on, or related to one or more, other knowledge domains. After analysis of his in-depth interview data, emergent activities of information seeking were grouped into three categories named core processes: Opening, Orientation, and Consolidation.

Opening refers to the process of moving from a state of orientation to actually seeking, exploring and revealing information. *Opening* implies how they open up their topics through information seeking activities. It represents a collection of non-linear activities, namely breadth exploration, eclecticism, networking, keyword searching, browsing, monitoring, chaining, serendipity. Every single activity might interact with or inform other *Opening* activities as well as other core processes.

Orientation processes are a diverse range of activities focusing on identification and the direction in which to look. These activities include reviewing, picture building, identifying keywords, source identification & selection, and problem definition. During *Orientation* processes, the key themes, keywords, latest opinions and recourses, and picture building can be identified. According to Foster (2005), *Orientation* performs the basic problem solving aspects identified in previous research.

The main goal of the *Consolidation* process is to judge and integrate the work in progress and to decide if further information seeking is required. The activities in this process include refining, sifting, incorporation, verifying, finishing, and knowing enough. As a main concept in this process, knowing enough iteratively questions whether sufficient information has been acquired for the need. According to Foster (2005), *Consolidation* loops and intertwines with the *Orientation* and *Opening* processes in the context of inter-disciplinary research.

Apart from these three core processes, Foster (2005) proposed that information behaviour is not isolated from the internal and external context in which researchers work. He outlined many major external factors such as social and organizational, time, the project, and access to sources. On the other hand, the internal context mainly refers to the experience and knowledge held by the researchers, which includes feelings, thoughts, coherence, knowledge and understanding.

According to Foster (2005), the cognitive approach is the most intimate factor in information seeking behaviour. It refers to the mode of thinking of a researcher during the information seeking process. Four cognitive approaches were identified in Foster's (2005) study: the flexible and adaptable approach, open-minded approach, nomadic thought, and the holistic approach.

Figure 4-5 displays this non-linear model of information seeking, reflecting the experiences of the information seekers in Foster's study (2005). Instead of depicting the relationships between the individual activities, this model mainly focuses on the interaction between the core concepts. According to Foster (2005), the three core processes take account of the interaction between the researchers' cognitive approach and the internal and external contexts in which they work.

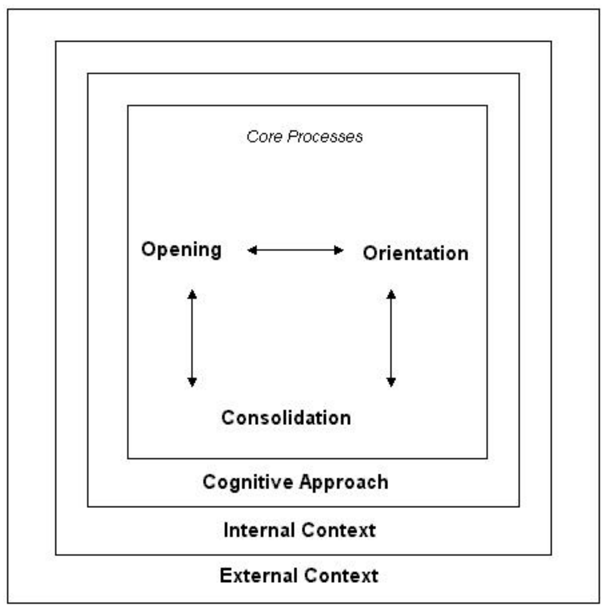


Figure 4-5: Non-linear model of information seeking (Foster, 2005)

4-4 Dervin's Sense-Making theory

4-4-1 What is Sense-making

Apart from the different information seeking models described above, another theory about information seeking behaviour that has been widely discussed and employed is Dervin's (1983, 1998, 2003) Sense-Making theory. According to Dervin (1983), the word 'sense-making' is employed to refer to a coherent set of concepts and methods in her studies that explores how people make sense of the worlds around them. In her research, Dervin explores how people construct their information needs and how people use information during such sense-making processes.

Dervin (1983) defined 'sense-making' as both internal (i.e. cognitive) and external (i.e. procedural) behaviour that allows people to construct or design their movement through time-space. Sense-making is implemented in terms of four constituent elements: situation, gap, outcome, and bridge. *Situation*, related to time and space, refers to the context from where problems arise, and where sense is constructed. *Gap* is the difference between the existing situation and the desired situation, namely the problem, or 'information need' in many other information studies. *Outcome* refers to the results of the sense-making process. *Bridge* refers to the means of closing the gap between the existing and desired situation. In Dervin's (1983) perspective, when people perceive that they are facing a situation in a particular time and space, they are able to construct a temporary ordered reality, that will guide their behaviour. However, when the situation (space, time etc.) is changed, they will behave differently.

She employed a metaphor (Figure 4-6) to depict how people seek information: human beings travel through time-space; they come out of situations with history and partial instruction; they arrive at new situations; they face gaps; they build bridges across those gaps; they evaluate outcomes and move on (Dervin, 1998).

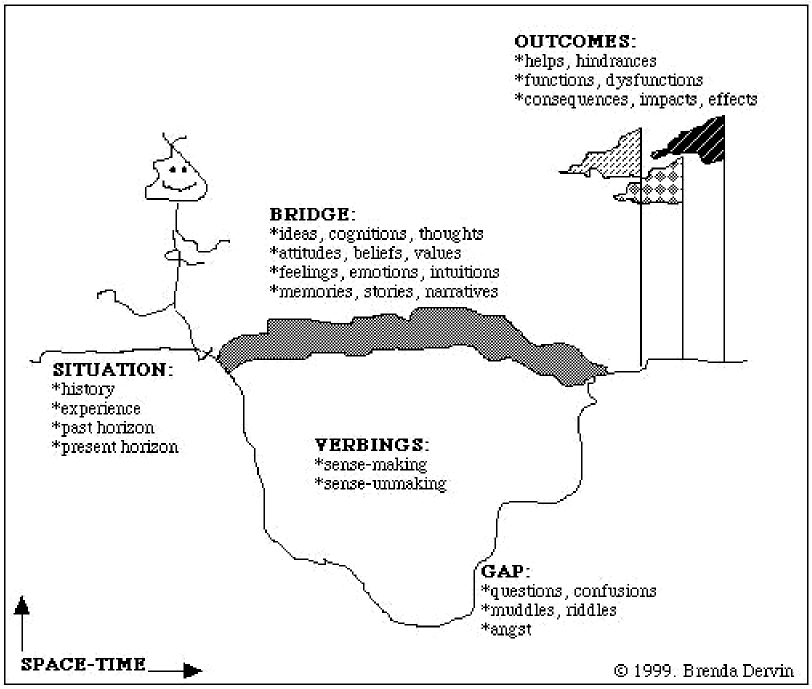


Figure 4-6: Dervin's Sense-Making metaphor (Dervin, 2003)

The key element of sense-making is its focus on how individuals construct their pictures of reality and consequently to guide their behaviours. Information means different things to different users. Even for the same person, he might perceive information differently and apply different information skills, when the situation varies. So the process of information seeking is always uncertain and flexible. However, according to sense-making theory, we can focus on the changing situation as a predictor to successfully predict the sense-making behaviour.

Dervin (1983, p6) herself asked the question: “what situational conditions will relate to what sense-making behaviours?” Consequently, this theory cannot be seen simply as a model but instead a framework of a model, or a methodology. As argued by Dervin (1998), Sense-Making is a metaphorical framework, not a literal map.

4-4-2 Underlying assumptions of sense-making theory

According to Dervin (2003), sense-making theory is based on a set of assumptions and propositions about the nature of information, use of information, and human communications. It is these assumptions and propositions that provide methodological guidance for framing research questions, data collection and analysis. The core assumption on which sense-making theory rests is discontinuity.

The assumption of discontinuity implies that there are discontinuities in all existence, including entities, times, and spaces. This discontinuity exists along the whole chain of the sense making process: from the reality to human sensor, mind, tongue, message created, channel selected to communicate, and so on. It also exists within the one individual at different times, or between different people at the same time, and so on. Dervin (2003, p271), argues that “discontinuity is an assumed constant of nature generally and the human condition specifically.” It is such an assumption that makes it possible for sense-making theory to help us explore and understand information behaviours that are internally controlled by individuals.

Based on the above discontinuity assumption, information is conceptualised as the sense that is made by human beings at a specific time, and in a specific space. Information is thus something that exists among human behavioural activities. However, this does not assume that, like the perspective of a radical constructivist, there is no order out there. Instead, it assumes that, for humans as observers, there is no direct access to whatever order out there, as our observations are limited by time, space, and individual capabilities. In other words, the order that we live in is not given, but is made or constructed by ourselves. As a result, information seeking and use should be a constructive process rather than a simple transmissive one.

According to sense-making theory, studies in information seeking and use behaviours are supposed to be based on the perspective of the actor rather than the perspective of the observer. So, research in information seeking and use should focus on information seekers themselves. We should ask questions in a user-oriented way so that the data collected will reflect the way they construct or make the sense of the world. Sense-making theory focuses on users' behaviours, which might be either internal such as comparing, categorizing, liking information, or external such as attending, listening, and agreeing.

4-5 Problem solving process

4-5-1 An overview of problem solving research

Problem solving is a topic that has been the focus of inquiry for many years in psychology. Many conceptions of the problem-solving process have been proposed, ranging from learning approaches (such as Kendler & Kendler, 1962) to traditional cognitive approaches (such as

Maier, 1970), and computer simulation and mathematical models (such as Newell and Simon, 1972). Differences in conceptions of the problem-solving process have sharply divided psychologists. As a result, many experiments have been performed in an attempt to clarify the crucial variables in the problem-solving process. These experiments include matchstick, bent nail, and jigsaw puzzles, game, anagram problems, concept-identification problems, arithmetic problems, and so on. Although more is now known about problem solving, how people solve problems is still largely unknown.

Another area which is closely related to problem solving is decision making. According to Herbert (1986), the work of choosing issues requires our attention, such as setting goals, finding or designing suitable courses of action, and evaluating and choosing among alternative actions. “The first three of these activities--fixing agendas, setting goals, and designing actions--are usually called *problem solving;* the last, evaluating and choosing, is usually called *decision making”* (Herbert, 1986). Developed from operational research, decision making research has been explored in accounting and management sciences since 1960s , and continued with expert system and artificial intelligence research since late 1970s (Kim, Yang & Kim, 2008). Although problem solving and decision making are so close, their research has different origin and trace of development. Due the purpose of this research, a total review of decision making is not possible. This study will only focus on problem solving research which has been more related to learning.

Research in the cognitive processes involved in human problem solving has developed along two main perspectives. The first focuses primarily on the use of information-processing models to characterize adult processing of well-defined problems that have specifiable knowledge bases. The second perspective focuses primarily on learning, or cognitive developmental issues.

Learning has long been discussed, together with problem solving, in the literature. According to Anderson (1993), early learning experiments in the 19^{th} century involved cats learning to solve the problem of getting out of a puzzle box. It was concluded that the cat managed to get out of the box by a trial and error process. But, at that time, this experiment was not recognised as a kind of problem solving, but as a process of the gradual strengthening of successful responses. The American educational philosopher John Dewey (1859-1952) is regarded as the founder of the concepts of 'learning by doing' and 'life-long learning' (Fainburg, 2009). His research relied on problematic situations and reflective thinking, and through these he developed his problem solving mode. As stated by Fainburg (2009), Dewey's theories focussed on the relationship between thinking and action where problem solving is a learning process.

Information processing and information seeking has long been related to problem solving. Newell and Simon (1972) regarded both the human mind and the computer as a kind of "information processing system" and argued that problem solving could be modelled by a machine. By assuming that behaviour is a function of memory operations, and of the control rules and processes, they developed the GPS (General Problem Solver) Model that attempted to define the core processes that a solver could use to face different kinds of problems. In most information seeking research, information seeking and retrieval behaviours are triggered by information need (Wilson, 1999), while this need is caused by a gap or uncertainty. But, what causes this gap or uncertainty? A natural answer is 'a problem'. Wilson (1999) argues that this problem may be more or less recognisable as a problem in the normally understood sense of the word, but will usually be something in the individual's everyday life or the work life of the scientist, professional worker and so on. In other words, the individual is faced with a problematic situation. The same understanding can also be found in Dewey's work (in Fainburg, 2009). According to Fainburg (2009), Dewey found that only problem solving initiated uncertainty and perplexity. From this perspective, Wilson (1999) developed his problem solving model of the information seeking and searching process.

4-5-2 Problem solving process models

The research with regards to problem solving can be traced back to early 1900s. Many problem solving models have been developed since then. Much effort has been made to identify the different elements among the models and the concepts. According to Roth and McGuinn (1997), there are two different forms of model in the literature: linear models and cyclic models. The linear models describe problem solving as a relatively unvarying sequence of steps, whilst cyclic models regard the steps of problem solving as a cycle. In the cyclic model, each end of a step is the beginning of another. However, other researchers categorize the models from different perspectives. For example, Funke and Frensch (1995) arrange the theoretical developments according to different traditions. According to them, the North American models have a functional base, whilst the European theories appear to have a structuralist tendency. Botia & Orozco (2005) use the molar and molecular categories to classify problem solving models. Molar models are those oriented to global analysis, while molecular models are those identifying processes, operations or components that take part in problem solving in a sequential or integrated manner. A thorough review of all the models is beyond this research. Only some major problem solving models will be reviewed here to understand what happens in this process.

C’zurilla and Goldfried (1971) define ‘problem’ as a specific situation, or set of related situations, to which a person must respond in order to function effectively in his environment, whilst a situation is considered ‘problematic’ if no effective alternative response is immediately available to the individual confronted with the situation. Based on this understanding, problem solving is defined as a behavioural process, whether overt or cognitive in nature. This process makes available a variety of potentially effective response alternatives for dealing with the problematic situation. Furthermore, it increases the probability of selecting the most effective response from among these various alternatives. In this way, problem solving may be seen as those activities that include not only the generation of alternative responses, but also decision making or choice behaviour. Placing problem solving into "real-life" situations, C’zurilla and Goldfried (1971) proposed their problem solving model, involving several stages:

1) General orientation. This refers to an individual’s general orientation or set in approaching a problematic situation. It normally includes the following set of attitudes: (a) accept the fact that problematic situations constitute a normal part of life and that most of these situations can be handled effectively, (b) identify problematic situations when they occur, and (c) inhibit the tendency to either respond on the first impulse or do nothing.

2) Problem definition and formulation. This stage seeks to avoid an unwanted source of variance in problem solving performance. The stage involves defining all aspects of the

situation in "operational" terms, and formulating or classifying elements of the situation appropriately, so that relevant information can be separated from irrelevant information, the primary goals are identified, and the major sub-problems, issues, or conflicts specified.

3) Generation of alternatives. This includes identification of a number of alternatives for resolving the problem. The major task here is to generate possible solutions appropriate to the problem identified previously.

4) Decision making. By generating a number of alternative courses of action, the problem solver will have to make a decision as to which option can be applied to solve the problem. This requires that the consequences of each alternative must be considered and judged against a set of criteria.

5) Verification. The purpose of all previous stages has been to maximize the chances that the chosen course of action will have a favourable outcome. Therefore, this final stage of problem solving takes place after the chosen course of action has been carried out and is designed to assess the actual outcome so as to make self-correction possible. In other words, this stage involves two aspects: implementation and outcome evaluation.

Johnson (1944) argues that problem solving begins with the initial orientation and ends with the closing judgment, but between these bounds almost anything can happen, in any sequence. He further argued that problem solving or deliberation may be separated into three processes, or groups of processes, which regularly occur during problem solving: 1. Orienting to the problem; 2. Producing relevant material, an elaborative function; 3. Judging, a critical function.

The first stage, "orientation", refers to the process by which the organism grasps the material of thought and keeps it available for deliberation. According to Johnson (1944), the individual is oriented towards words or other symbolic representations of certain aspects of the environment, and thus has something "in mind". This is a popular equivalent of "orienting toward" something when the objects of thought are absent or abstract. In this sense, orientation is the receiving function of mental activity. The second stage, "Producing relevant material", refers to "a congeries of processes, since the materials of deliberation and the ways of manipulating them are variegated" (Johnson, 1944, p203). The material may be produced by perceptual processes, as in the psychophysical judgment, from the present situation, or may be remembered from the past, namely the memory or learning process, or may be communicated from others. The judging or evaluative stage includes selecting the alternatives from those elaborated. Johnson (1944, p203) states that this phase "claims relation between aspects of the problematic situation or the elaborated material which renders the situation less problematic, thus releasing the orientation".

Based on introspections and informal observations, Wallas (1926, in Zhong etc., 2010) developed conceptual procedures for problem solving in a creativity context. According to Wallas (1926, in Zhong etc., 2010), the creative problem solving procedure involves four phases: preparation, incubation, inspiration, and verification. The first phase, preparation, defines the problem and gathers information relevant to its solution. The second phase, incubation, concerns thinking about the problem at a subconscious level while engaging in other activities. The third phase, inspiration, refers to the problem solver getting a sudden insight into the solution of the problem. The fourth phase, verification, concerns checking if the solution is correct. Following Wallas' work, another generic empirical process of problem solving has been proposed by Polya (1954, in Zhong etc., 2010), including understanding the problem, devising a plan, carrying out the plan, and looking backward. The first phase, understanding the problem, involves indentifying the problem's knowns (givens) and unknowns. In the second phase, a plan is devised by determining appropriate actions to take to solve the problem. The third phase involves carrying out the plan by executing the actions that have been determined to solve the problem and checking their effectiveness. Finally, the last phase, looking backward, refers to evaluating the overall effectiveness of the approach to the problem, with the intention of learning something about how similar problems may be solved on future occasions.

Although these problem solving models above were developed long ago, they are still valid nowadays. Chakravorty, Hales, & Herbert (2008), for example, developed their own 5S problem solving model for the use in providing initial training to employees based on the works of Wallas (1926), Johnson (1944), and Polya (1945). There are 5 steps developed in their sequential model, which starts with problem identification, information gathering, generating alternate solution, evaluating solutions, and ends with implementing the best solution (Chakravorty, Hales, & Herbert, 2008).

Another problem solving model should be mentioned here is from Wilson (1999) due to its close relationship to the information seeking and searching process. According to Wilson (1999), problem solving is the underlying motivation for information searching. A problem will cause uncertainty. The goal of the problem solver is then to move from uncertainty to certainty, which can be regarded as goal seeking behaviour. The process of moving from uncertainty to increasing certainty is actually the problem-resolution process. There are identifiable and recognizable stages during this process: 1) problem identification, which is to answer what kind of problem it is; 2) problem definition, which is to answer what exactly the nature of the problem is; 3) problem resolution, which is to discover how we find the answer to the problem; 4) solution statement (potentially), which refers to the answer or a pragmatic resolution to the problem, namely, how we can deal with this problem. Wilson (1999) further emphasizes that each of these phases sees the successive resolution of more and more uncertainty. This might result in a feedback loop whereby you might return to a previous phase for further resolution when uncertainty fails to be resolved at any single phase.

4-6 Learning in a working environment

'Knowledge' and 'learning' often appear together. However, the different emphases on knowledge or learning in an organization have resulted in two separate camps: knowledge management and the learning organization. The Knowledge management literature tends to avoid referring to 'learning', while the organizational learning literature seems to omit what is learned. As a consequence, there has been a lack of attention given to the interconnection between knowledge and learning. As defined in the 'Dictionary of the English Language', learning is 'the act, process, or experience of gaining knowledge or skill', which tells us there is a close relationship between learning and knowledge. The definition, however, does not provide any explanation about how learning occurs or how knowledge is gained. Actually, many learning theories have been developed to explain how people learn, that is how they gain knowledge, for example, behaviourist theories, cognitive psychology perspectives, constructivist perspectives, and so on. In the following sections, the major learning theories will be reviewed, especially those related to learning in a working environment, namely informal learning, organizational learning, experiential learning, action learning, and situated learning.

4-6-1 An overview of learning theories

There are various paradigms of learning theories, such as behaviourism, cognitivism, constructivism, and so on. The early learning theory is behaviourism, which is mainly based on experiments with animals, and then generalized onto humans, such as Pavlov's dogs. It is also called classical conditioning.

In Pavlov's (1927) experiment studying the role of saliva in a dog's digestive processes, he accidentally found that his dog began salivating before the food was even presented. The salivation was triggered by the noise produced by the device that delivered the food. Based on this finding, Pavlov (1927) designed another experiment in which the food was paired with various stimuli such as a ringing bell. After the food and the ringing bell were presented together several times, the bell was used alone. As predicted, Pavlov found that the dog responded to the ringing bell by salivation, although there was no food together with the ringing bell. In his experiment, the food is an unconditioned stimulus and the dog's salivation is the unconditioned response. However, the ringing bell became the conditioned stimulus when the bell and food were repeatedly paired and the dog learned to associate the bell with food. Although the ringing bell did not make the dog salivate at the beginning, it became a trigger of the salivation response after pairing it with the unconditioned stimulus, the food. This experiment illustrated how stimulus-response bonds were formed, which are also seen as the basic blocks of learning.

Pavlov's work was extended and applied to human beings later on (Learning-theories-Knowledgebase, 2011). This classical conditioning was seen as an automatic type of learning which gains the capacity to form a response to the stimulus. This perspective is also regarded as a kind of behaviourism, as it emphasizes the principle of 'stimulus-response', and assumes that human beings are essentially passive, responding to the stimulus. Later on, another behaviourist perspective about learning, namely social learning theory, was introduced by Bandura (1977). This perspective assumes that human beings learn from one another by observing, imitating, and modelling others' behaviours. According to Bandura (1977), a person's behaviour and the world around are contextually interdependent. This is called 'reciprocal determinism'.

Compared to behaviourism, the cognitivist paradigm places emphasis on the human's cognition, the 'black box' of the mind (Learning-theories-Knowledgebase, 2011). People are not 'programmed animals', as in the behaviourist's perspective, which only respond to outside stimuli. According to the cognitivist perspective (Learning-theories-Knowledgebase, 2011), a person is seen as an information processor, and the process, or the inner mental activities, should be open and understood. The mental processes include thinking, memory, knowing, and problem solving. The information comes into one's mind, then it is processed by the mind, and finally leads to some outcomes.

For example, in Mayer's (1998) cognitive theory of multimedia learning, he assumes that there are two channels for information processing: auditory and visual. And, each of these two channels has a limited capacity. Learning is an active process to filter, select, organize, and integrate information based on the learner's prior knowledge.

Constructivism, however, regards learning as an active, constructive process (Learning-theories-Knowledgebase, 2011). The learner is not an information processor but a constructor. As one of the foundations of constructivism, Vygotsky's (1978) social development theory stresses the connections between human beings and the sociocultural context. According to Vygotsky (1978), the social interaction is the foundation of the cognitive development. There are two important concepts in his theory: More Knowledgeable Other (MKO), and the Zone of Proximal Development (ZPD). The MKO refers to those who have a higher ability level in some areas or aspects than the learner, and therefore can be a teacher or coach. The ZPD refers to the distance or gap between the learner's ability to complete a task or to solve the problem. Learning occurs in the ZPD.

In addition to Vygotsky, Lave and Wenger's (1991) Communities of Practice and Piaget's Stage Theory of Cognitive Development are all categorized as constructivist perspectives (Learning-theories-Knowledgebase, 2011). According to this kind of perspective, new information acquired by people is linked to prior knowledge and will be mentally constructed by the learner. Thus, the learners are actively constructing their own subjective representations of the reality.

There are still many other learning theories or perspectives. However, it is beyond the scope of this research to talk about them in detail. As this research focuses on knowledge seeking or learning in a workplace environment, the following sections will discuss learning in the workplace.

4-6-2 Learning in the workplace

Traditionally, we tend to relate learning to the formal education in schools. The concept of workplace learning is relatively new, as continuous learning is becoming more important for both individuals and organizations to compete since 1990s. Furthermore, according to Eraut (2004), methodological knowledge, generic knowledge and general knowledge about an occupation acquired by students in schools are not necessarily transferred into the workplace. As supported by some empirical studies (Tynjala, 2008), students normally find their working life skills inadequate, and most staff in a workplace think that their necessary skills for their jobs are not learned during their formal education but at work.

Learning in a workplace is different from learning in schools or universities. Hager (1998) argues that the formal learning in schools is normally planned and explicit, and mainly focused on individuals. The outcomes of formal learning are predictable. In contrast, workplace learning is more informal, which is unplanned and implicit, and normally collaborative and contextualised (Hager, 1998). The learning outcomes of the workplace learning are normally unpredictable. This means that learning in a workplace is mainly informal in the first place. In addition, it also means that learning in a workplace could exist at different levels, namely individual or organizational.

Holliday and Retallick (1995) defined workplace learning as the processes and outcomes of learning that individuals or groups of employees undertake under the auspices of a particular workplace. Based on this, Mathews (1999) argues that workplace learning should encompass the learning context, learning reason, learning process, learning outcomes, and development. According to Mathews (1999), workplace learning is extremely complex and requires the integration of many aspects such as adult learning theory, organizational needs and individual interests, the use of technology, the nature of the work environment, and so on.

4-6-2-1 Models of workplace learning

In order to gain a good understanding of workplace learning and a demonstration of the basic elements and their connections, many models have been developed. Rylatt (1994) proposed that, in order to develop a positive environment for workplace learning, a positive mindset is necessary. Rylatt (1994) argues that workplace learning is a systematic and interactive process, in which many influential factors must be considered. As shown in figure 4-7, the inputs of workplace learning, namely the policy, programs, strategies, and activities, should be closely tied to specific outputs, such as business results, better competency, and highly satisfied people. Otherwise, the result will be confused; the learning will be poorly integrated; and consequently, it will result in a waste of valuable resources.

Matthews (1999) criticized Rylatt's model by pointing out that no organization operates in a vacuum, and workplace learning will be influenced by both internal and external factors, such as government policies, organizational culture, organizational structure, technology, and employees. According to Matthews (1999), Rylatt's model is too simplistic and overlooks many other factors during the workplace learning process. To present a holistic view of workplace learning, Matthews (1999) proposed a new model trying to illustrate as many factors as possible based on Rylatt's model, such as the organizational characteristics, the individual emotional or subjective issues, the attitudes, commitment, values, motivational inputs, and the environmental influences external to an organization.

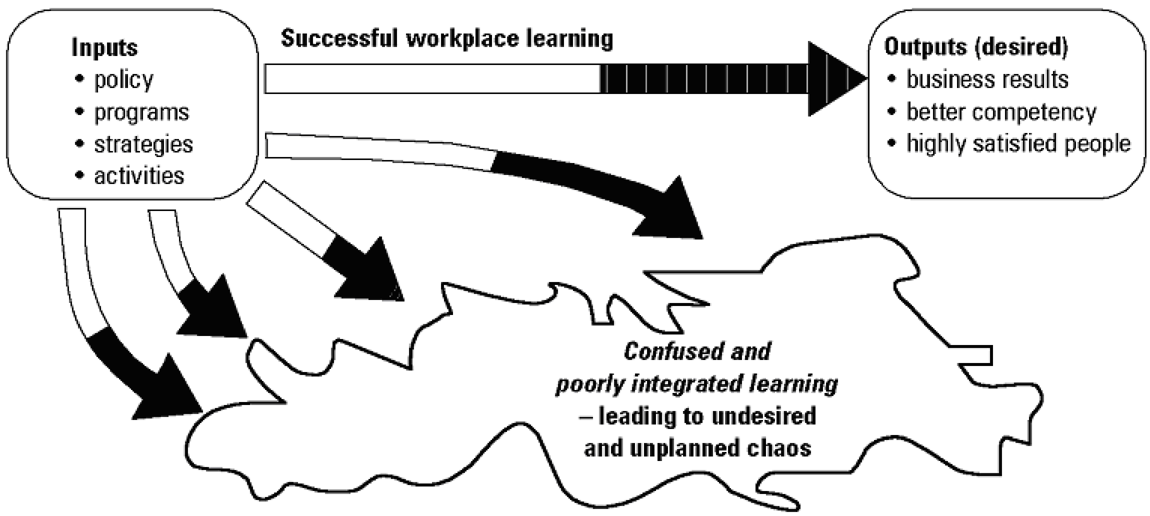


Figure 4-7 A systematic view of workplace learning (Rylatt, 1994)

Jorgensen and Warring (2001) argue that learning in a workplace occurs in the meeting of the individual learning process and the learning environment in the workplace. The learning environment includes two aspects, the social aspect and the material aspect. The social aspect refers to the social–cultural learning environment such as communities of work, cultural and political communities, whilst the material aspect refers to the technical organizational learning environment in a workplace, such as the division of work and work content and the possibilities of social interaction. Thus, workplace learning is actually taking place in the relationship of these three factors, namely the employee's learning process, the technical organizational learning environment, and the social cultural learning environment. This means that workplace learning is always influenced by the environment or the society where our working life is organized. Illeris (2004) names this relationship as 'working practice'. In other words, workplace learning takes place in the working practices.

However, as learning takes place in the interaction of the individual employee and the two learning environments, it is necessary to understand the individual dimension, namely how the individual learns. According to Illeris (2004), apart from the social interaction process between the learning and the environment, there is a psychological acquisition process at the individual level. This process contains two aspects, namely the learning content aspect and the dynamic aspect. The content aspect includes the knowledge, skills etc., whilst the dynamic aspect includes motivations and emotions etc.. Illeris (2004) argues that the working practice, namely the interaction process, is handled in the individual psychological acquisition process, and the transition between these two processes could be called individual 'work identity'.

Based on these two concepts, working practice and work identity, Illeris (2004) developed his new model about learning in a workplace (figure 4-8). As shown in the figure, the learning in a workplace is a complex process, which contains two different levels: the social level, and individual level. It takes place at the overlap area between the work identity of the employee and the working practice of the organization.

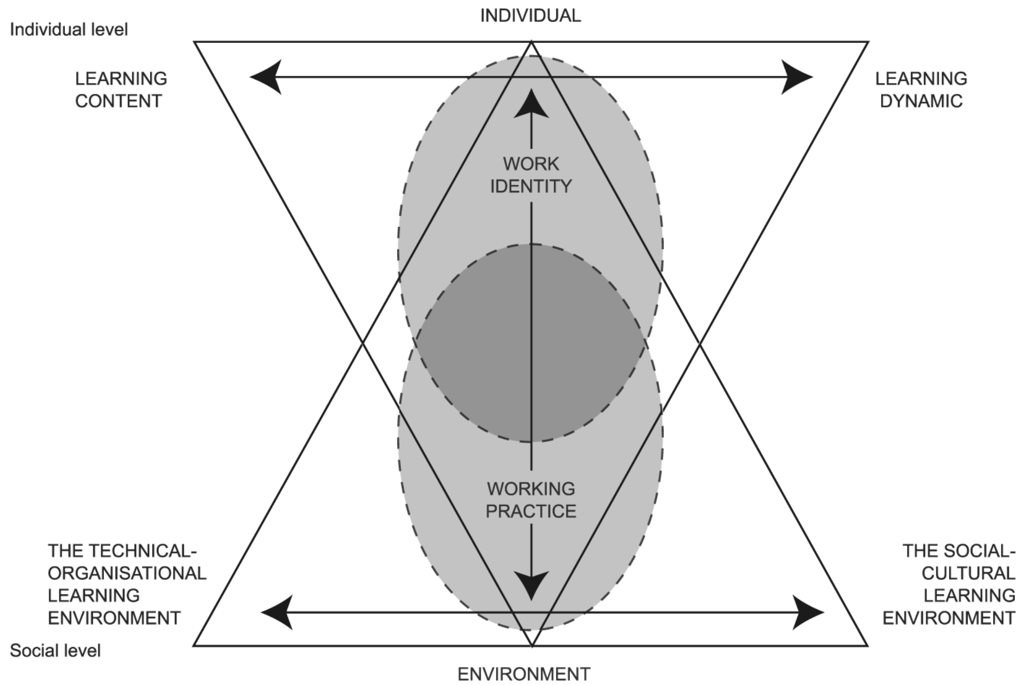


Figure 4-8 Learning in working life (Illeris, 2004)

4-6-2-2 Informal learning

A review of the models of workplace learning illustrated the factors involved in learning in a workplace. This section will discuss a major characteristic of workplace learning, namely informal learning. Compared to formal learning, which is normally classroom based and highly structured, informal learning is usually intentional but not highly structured. It is primarily controlled by the hands of the learner. Informal learning is also companied by another concept: incidental learning. According to Marsick and Watkins (2001), incidental learning, which is included in informal learning, is a by-product of some other activities, such as completing a task.

The literature relating to this topic illustrates that research in informal and incidental learning covers many contexts: universities, private and public sectors, health care and so on. According to Marsick and Watkins (2001), different organizational contexts produce different work assignments, while these assignments provide different opportunities for learning. Marsick and Watkins propose that informal and incidental learning take place as long as the individuals have the need, motivation, and opportunity for learning. Based on a review of studies of informal learning in the workplace, Marsick and Volpe (1999) listed some characteristics of informal learning: it is included in daily routines, triggered by an internal or external jolt, influenced by chance, linked to the learning of other individuals, and it is an inductive process of reflection and action with consciousness.

Based on the belief that individual behaviour is a function of their interaction with the environment, Cseh, Marsick and Watkins (1999) developed a model of informal and incidental learning (Figure 4-9). This model is arranged in a circle with context in the centre implying that learning is always undertaken within a given context. The environment or context plays an important role in influencing the learning process. Informal and incidental learning always take place with or without our awareness. As a new life experience tends to provide a challenge or a problem to be resolved, informal and incidental learning normally begins with such a trigger. Larson (1991) also proposes the same perspective by arguing that learning occurs most often when the learner is faced with an event or situation that is recognised as disconcerting or non-routine.

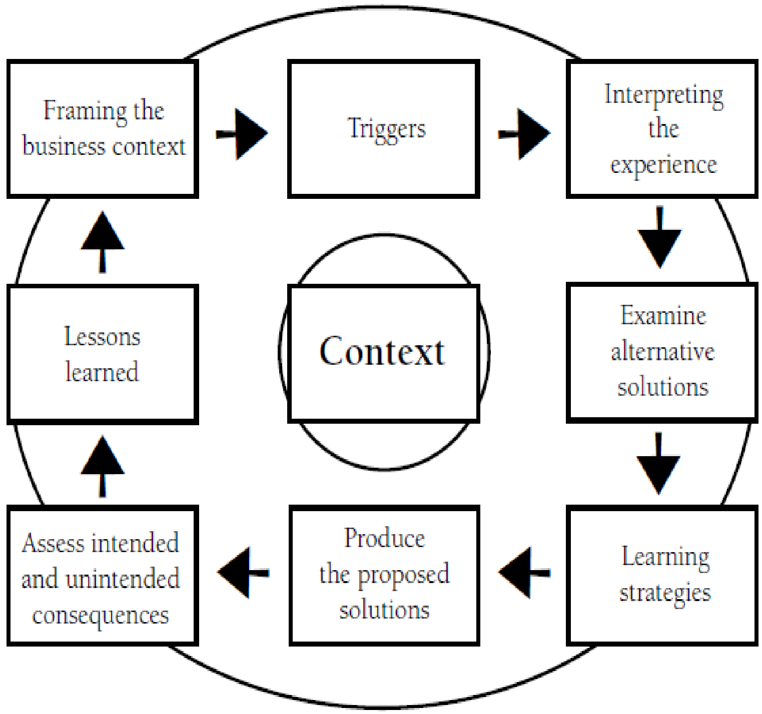


Figure 4-9 Informal and incidental learning model (Cseh, Marsick, Watkins, 2001)

According to Cseh et al. (2001), people will normally diagnose or frame the new experience, and assess the problem or challenge based on their prior experiences to interpreting the new challenges. They also refine their diagnosis by interpreting the context they are in, which will lead to choices about alternative actions. The contextual factors include the co-workers, the availability of resources, the willingness and motivation to learn, and so on. Once a solution is produced, people will normally assess the outcomes against their goals. This step will then make people draw lessons from it, which become new understandings or frames of reference. They will then bring them into a new situation and hence back to the beginning of a new cycle.

There are many factors influencing informal learning in workplaces. According to Knowles et al. (1998), informal learning is shaped by individual emotions. When faced with different individual circumstances, people may react differently, as emotions are integral to learning. As stated by Callahan & McCollum (2002), emotions can be used to help people adapt to change through formal or informal processes. Individuals' feelings influence their attitudes to learning needs, and their actions and behaviours in general. Furthermore, Hirsh and Kummerow (1990) argue that personal characteristics, such as age, educational background, may have impact on the degree of engagement in informal learning. For example, Kremer's (2005) research indicates that younger or less experienced employees engage in more informal learning, while senior employees are not likely to do so. Livingstone (2000) suggests that younger learners tend to seek others' help in informal learning, while senior learners tend to act individually.

In order to enhance informal learning in the workplace, Marsick and Watkins (2001) propose three conditions. First, reflecting critically so that tacit knowledge and beliefs surface. Second, stimulating the learner to actively learn new skills. Third, creativity to produce a wide range of options. In addition, they argue that since informal learning is unstructured, it is likely to be trapped by an individual's blind spots, or misperceptions. Consequently, Marsick and Watkins (2001) suggest that people learn in groups or other social settings, as the interpretation of a situation and our actions are greatly influenced by the social and cultural norms of others. This leads to diversities of learning at different levels in a workplace. The following section will address this issue, namely organizational learning.

4-6-2-3 Organizational learning

Learning in a workplace also implies that processes take place at different levels: individual, group, organization, and even network and regional levels. The concept of organizational learning emerged around the 1980s, although its theoretical root can be traced back to many management perspectives. It is normally accompanied by another notion: the learning organization. As has been discussed in Chapter Two, there is some confusion around these two concepts. However, the central theme of both organizational learning and the learning organization is whether learning can be managed and how. According to Ellinger et al (2002), most research concerning the learning organization focuses on the importance of acquiring, improving, and transferring knowledge, facilitating individual and collective learning, and integrating and modifying behaviors and practices of the organization and its members as a result of the learning. Firestone & McElroy (2004) regard the learning organization as the 'normative aspect' of organizational learning. This kind perspective can also found from Tsang (1997), who states:

> ***Organizational learning is a concept used to describe certain types of activity that take place in an organization while the learning organization refers to a particular type of organization in and of itself … a learning organization is one which is good at organizational learning. (Tsang, 1997, p75)***

Marsick and Watkins (2001) define learning at the individual level as the way people make meaning and acquire knowledge and skill, while learning at the organisational level is that which is embedded in systems, policies, organizational mental models, procedures, and so on. However, according to Cohen & Sproul (1991), there are many other explanations concerning organizational learning, which bear many criticisms as the definitions come from different perspectives and are extremely broad, encompassing all organizational change. Many disciplines have been involved in this area, such as management theory, organization theory, system theory and psychology.

Argyris and Schon's (1978) single-loop and double-loop learning is arguably one of the earliest theories concerning learning at an organizational level. After that, the research on organizational learning or learning organization began to flourish in 1990s, such as Levitt and March (1988), Senge (1990), Pedler et al. (1991). According to Argyris and Schon (1978), there are two levels of organizational learning when the organization responds to changes in the environment: single-loop and double-loop. The single-loop learning refers to learning without changing the core set of organizational norms, whilst the double-loop learning tends to change the core set of organizational assumptions. As argued by Bierly, Kessler, and Christensen (2000, p598), "single-loop learning is learning within a given framework and double-loop learning is learning by changing the framework".

As many early researchers emphasize the role of individual learning in organizational learning, Argyris and Schon (1978) regard individuals as agents for organizations to learn. As stated by them, "organizational learning occurs when individuals within an organization experience a problematic situation and inquire into it on the organizational behalf" (Argyris and Schon, 1978, p16). In this perspective, organizational learning is the collective individual learning in the organization, and a learning organization could be nurtured when the individuals consciously interact with others and learn (individual learning theories have been reviewed previously at the beginning of this section, See p111). Consequently Scarbrough et al. (1998) argue that an organization should stress the individual development of its employees.

However, Field (1997) points out that individual learning does not necessarily lead to organizational learning, as employees may learn to improve themselves while not benefiting the organization. Furthermore, individuals may also learn something negative to the organization. Learning at an organizational level is complex. If organizational learning is simply regarded as the extension of individual learning, the complexities of organizational learning will be neglected.

Some researchers regard an organization as a learning system (Revans, 1982; Huber, 1991; Glynn et al., 1992). According to this system view, an organization is seen as an information processing system. Hence, organizational learning should focus on the information processing in the system, such as acquiring, interpreting, distributing, and storing information. Based on this, Huber (1991) proposes four steps in the organizational learning process, namely knowledge acquisition, information distribution, information interpretation, and organizational memory.

This leads to another notion: knowledge management. Bierly, Kessler, and Christensen (2000, p597) define learning as the "process of linking, expanding, and improving data, information, knowledge and wisdom". Lyles (1992) argues that organizational learning refers to the changes in the state of knowledge. Organizational knowledge is partly stored at the individual level in terms of experiences, skills, and so on. It also exists at organizational level as documents, rules, regulations and so on. Thus it should be managed in organizations so that the learning environment between individuals and the organization is facilitated or strengthened. This kind of perspective echoes Nonaka and Takeuchi's (1995) knowledge creation model, which proposes that the new knowledge will be created or individual knowledge become organizational, when the knowledge is transferred between the individual level, group level, and organizational level.

Developed from individual learning, organizational learning theories have been evolving since the 1980s. Different focuses or perspectives have resulted in diversified understanding of the learning at the organizational level in the workplace, which helps organizations in creating competitive advantages. These perspectives tend to overlap each other and do not exclude one from another. As stated by Wang and Ahmed (2003), an effective blend of focuses, based on the specific situation in an organization, is the best way to make sure that organizational learning in the workplace is successful.

4-6-3 Experiential learning

Previous sections in this chapter have reviewed learning theories in general, the workplace learning models, and two major characteristics of the learning in a workplace. Firstly, the learning in the workplace is normally informal and incidental; secondly, the learning in the workplace could exist at different levels, such as individual or organizational level. In this section, some learning theories especially relating to the workplace will be reviewed.

As mentioned previously, the behaviourist perspective of learning stresses behavioural techniques in training learners' responses, but denies the role of subjective experiences in the learning process. The cognitivist perspective tends to focus on the learners' cognition. The experiential learning theory, developed by Kolb (1984), aims to emphasize the critical role of experience in the learning process. According to Kolb (1984, p38), "learning is the process whereby knowledge is created through the transformation of experience". From this perspective, knowledge is created by grasping and transforming experiences, which constitute the two structural dimensions of the experiential learning process (shown in figure 4-10).

In the grasping experience dimension, there are two dialectically opposed forms of prehension: ‘concrete experience’ via ‘apprehension’ and ‘abstract conceptualisation’ via ‘comprehension’. According to Kolb (1984), apprehension implies the primary mode of knowing, such as what we see, hear, and feel around us, which we know instantaneously without need for rational inquiry or analytical confirmation. Comprehension implies those concepts and the associated mode of knowing, which is the secondary and somewhat arbitrary ways of knowing. As stated by Kolb (1984, p43), the comprehension of some situation “will allow you to create for yourself and communicate to others a model of that situation that could last forever”. In other words, comprehension is constructed from, and may predict and recreate, the apprehension.

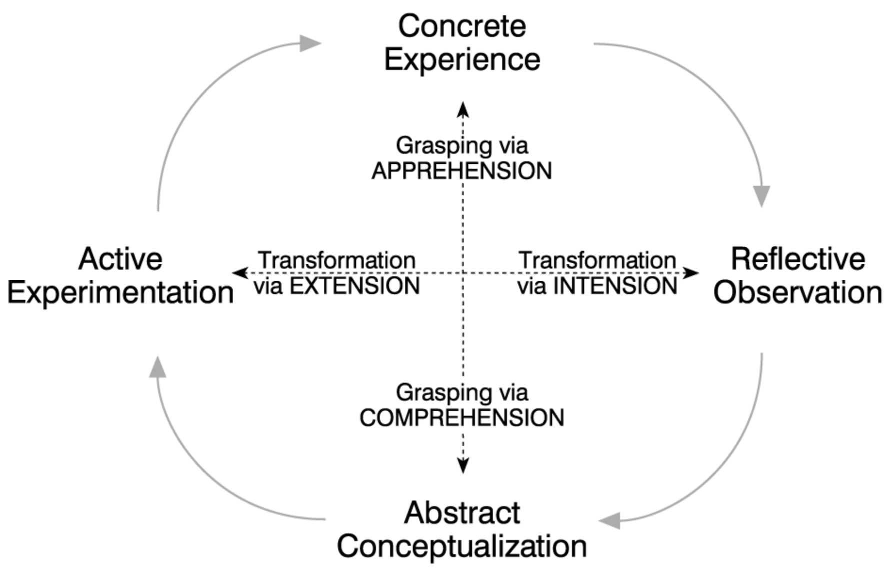


Figure 4-10 Experiential learning model (Kolb, 1984)

Kolb (1984) also quoted William James's work about 'knowledge of acquaintance' and 'knowledge-about' to explain the relation between apprehension and comprehension:

> ***"What we are only acquainted with is only present to our minds; we have it, or the idea of it. But when we know about it, we do more than merely have it … through feelings we become acquainted with things, but only by our thoughts do we know about them" (James 1890, in Kolb 1984, p44)***

In the transforming experiences dimensions, the two opposed forms are 'active experimentation' via 'extension' and 'reflective observation' via 'intention'. According to Kolb (1984), the 'extension' and 'intention' are selected to represent the basic transformation process of learning, because the transformation processes of intention and extension can be applied to both the concrete apprehensions and the symbolic comprehensions of the world. As argued by Kolb (1984), we learn the meaning of our concrete immediate experiences by internally reflecting on our previous feelings or by acting on our apprehended experience and thus extending it. Furthermore, the new extended apprehension will stimulate our internal reflections and feelings again. Based on this, learning takes place through this active extension by grounding ideas or experiences in the external world, and through internal reflections about these ideas and experiences.

From the perspectives of experiential learning, the two basic structural dimensions of learning process result in 4 forms of knowledge: divergent knowledge, which is grasped through apprehension and transformed through intention; assimilative knowledge, which grasped through comprehension and transformed through intention; convergent knowledge, which is grasped through comprehension and transformed through extension; and accommodative knowledge, which grasped by apprehension and transformed by extension. According to Kolb (1984), previous concrete experiences are the basis for reflective observations. The reflections will then assimilated and distilled to abstract concepts. These abstract concepts have implications for new actions as guides and will be tested via experimentation, from which the new experiences will be created. A new learning cycle then starts again. It is a recursive process.

Furthermore, the complex structure of experiential learning allows for the emergence of individual styles of learning, as the learners' different preference for the four modes in the learning process: concrete experience (CE), reflective observation (RO), abstract conceptualisation (AC), and active experimentation (AE). According to Kolb and Kolb (2005), learners who rely on CE are normally open to new experiences and are good at relating to and rely on people to use other's feelings and values. They mainly are concerned with the uniqueness of the present reality. Learners who rely on AC, however, tend to be logical and analytical. They like ideas and theories, and tend to rely less on people, but seek theories and generalizations. With regards to the dimension of transforming experience, the learners who emphasize RO tend to watch and observe all sides of an issue in order to understand its meaning and take time to act. In the contrary, learners who prefer AE like to try things out, are more willing to take risks and are practical and application oriented (Kolb and Kolb 2005).

Based on an individual's preference for using a combination from the above four dialectic modes, Kolb and Kolb (2005) proposes four basic learning styles, namely Diverging, Assimilating, Converging and Accommodating. Diverging types rely on learning through CE and RO, Assimilating learners prefer to make more use of RO and AC, Converging learners mainly use AC and AE, while Accommodating learners prefer to AE and CE.

4-6-4 Action learning

Similar to experiential learning, action learning emphasizes the experiences as well although there are still many different understandings about what action learning is in academy and practices. As stated by Weinstein (1995), one of the problems of defining action learning is that it means differently to different people.

As the ‘father’ of action learning, Revans (1982, p626) originated action learning and defined it as ‘a mean of development through responsible involvement in some real, complex and stressful problem to achieve intended change to improve their observable behaviour henceforth in the problem field’. Revans (1982) also proposed the equation for learning: ‘L = P + Q’, in which L represents learning attained through engagement in action, P represents learning gained from accepted authorities or programmed knowledge from the past, and Q represents learning initiated as people question their own direct experience. In other words, learning is programmed knowledge plus questioning insight. This model of learning argues that individuals in the workplace learn from experience through reflection and action, usually to solve problems they meet at work. In other words, learning occurs in the process of finding solutions to problems in the workplace.

Another concept emphasized in Revans’ action learning is ‘learning sets’. According to Revans (1982), action learning occurs through learning sets, which refers to a group of people (up to eight usually) in roughly comparable situations. As stated by Zuber-Skerritt (2002), action learning is learning from and critical reflection upon concrete experience through group discussion, trial and error, and discovery. People learn from each other within the group by address some problems or issues from workplace. The group here is not like a project team to complete a task collectively but a forum where the members in the learning sets are helping each other. Only the problem owners are responsible for solving their own problems. It is the process of finds solutions to their own problems that action learning takes place. Therefore, action learning is both individual and social. Revans (1982) concluded that people learn only when they want to; that one important reason for wanting to learn is an awareness of their incapacity to complete a job.

Some researchers connect Revans' action learning to Kolb's experiential learning seeing Kolb's theory as a theoretical base (like McGill and Beaty, 1992; Mclaughlin & Thorpe, 1993). Marsick and O'Neil (1999) identified this research as the experiential school of action learning. According to them, action is the start point for learning, and people reflect on their experience with the support of others from the learning sets and followed by action again. Namely learning occurs in each stage of the experiential learning cycle. The researchers from this school of action learning agree with Revans' learning equation and even have developed it further. For example, Inglis (1994) adds 'Implementation' into Revans equation by arguing that action must be taken not just suggested from others.

There are some other researchers in action learning emphasizing the importance of 'critical reflection', such as O'Neil and Marsick (1994), Weinstein (1995), who argues that reflection is powerful in action learning but critical reflection can be more powerful as our attention will be directed to the root of problems. These perspectives are identified as the ‘critical reflection school of action learning’ by Marsick and O’Neil (1999). According to them, critical reflection can go beyond the individual ‘s underlying assumptions and thus transform perspectives to gain a better understanding of the insights, and possibly to reformulate the presenting problem.

Although there are different emphases in different schools of action learning, there appear to be many consistent elements among them. Based on this, we can summarise here some the key words of action learning: experience, reflection, problem oriented and job related, learning sets. An often-cited piece from Pedler (1997) could serve as a summary of the meaning and assumptions of action learning:

> ***“Action learning is an approach to the development of people in organizations which takes the task as the vehicle for learning. It is based on the premise that there is no learning without action and no sober and deliberate action without learning.” (Pedler 1997, p26)***

4-6-5 Situated learning

Another approach that is receiving attention in workplace learning is situated learning theory, which regards learning as an integral and inseparable aspect of social practice. The situation and circumstances is influential to the learning. Brown et al. (1989) defined situated learning as a learner executing tasks and solving problems in an environment that reveals the various intended uses of the knowledge. As summarized by Hooks (1994, in Fox 1997 p732), ‘it does not see mind as a container waiting to be filled up but sees mind-in-action in the everyday world, creating knowledge and learning simultaneously in interaction with the social and material aspects of the lived-in-world'. Based on this perspective, knowledge is not independent but embedded in the circumstances of it application. Knowledge is not a thing and we do not learn via transferring this thing from one head to another. According to Stevenson (1991), situated learning theory regards the transfer of knowledge as a product of higher order thinking that enables the abstraction of principles applied from specific instances to novel situations.

Situated learning is also regarded as the bridge between the cognitive theory and sociocultural perspective. From a cognitive perspective, the knowledge in mind refers to individual cognitive structures including conceptual and procedural knowledge, which is an internal product. However, from a sociocultural perspective, the representations of knowledge in mind refer to culturally shaped dispositions, which developed by the outside social circumstances. As the bridge of these two perspectives, the situated learning theory emphasizes the mutuality between the individual cognitive structures and the social circumstances, and states that the cognitive structures are constructed and developed in a certain social circumstances.

Lave and Wenger (1991) demonstrated this theory by observations of different apprenticeships, such as midwives and meat-cutters. They tried to place learning into the social relationships, and focus on the social engagement in the learning process. They found that the social activities provide the context for learning, and learners fully participate in frameworks that have structure, namely the socio-cultural practice of a community, and construct identities in relation to these communities. 'Learning, as increasing participation in communities of practice, concerns the whole person acting in the world' (Lave and Wenger, 1991, p49). This shows the emphasis on the individual identity and the situated and mediated nature of learning. According to them, the identity, practice, and the participation in a community are the major themes in the situated learning theory. They thus introduced the conception of 'community of practice' (CoP) and stated that the CoP is developed through social activities and interaction.

According to Lave and Wenger (1991), CoP could be everywhere and is formed by people who engage in a collective learning process in a shared domain, such as a group of engineers working on similar problems. These groups could be formal or informal. You may belong to different CoPs at the same time, or be a core member in one group whilst being at the margins in another. The people in such groups share their concerns and passions of what they are doing and interact regularly to learn from each other how to do their jobs better. CoP is different from other kinds of community as the group members come together for the common activities and share their practices, such as experience, stories, and tools for the problems they meet in their work.

As they stress the social relationships where learning occurs, Lave and Wenger (1991) focus on the situations of participation in the CoP. According to them, learners understand the world via their participation in the structured frameworks. This is an active participation in the practices of social communities. Learners construct identities in relation to the CoP as well. When the learners become more involved in the community, they move from legitimate peripheral participation as a newcomer towards full participation. In this sense, the process from 'legitimate peripheral participation' to a 'full participation' is the socio-cultural process where learning takes place.

The CoP has been widely discussed in knowledge management research and practices as it provides a new approach to understand knowledge in organizations. From the perspective of CoP, the knowledge of an organization is not retained in the database or other repository but, in a living way, by CoP. KM should then stress the development of CoP in organizations, namely the people and social structures, in order to aid the learning process.

4-7 Preliminary framework for knowledge seeking

Knowledge is special and is not a kind of goods which can be found from somewhere or from someone directly. So knowledge seeking is not like seeking something from somewhere, but a complicated learning process. The following sections will summarize previous sections to bring out the underlying links between the related literature with regards to knowledge seeking, namely experiential learning, problem solving, and information seeking. This leads to a preliminary framework for knowledge seeking in this research. In addition, the a priori codes for the knowledge seeking process will be identified for later exploration in this thesis.

4-7-1 The links among the literature and the preliminary framework

4-7-1-1 Experiential learning and problem solving

In this PhD research, knowledge seeking in the workplace is defined as a learning process, which places emphasis on individual cognitive process of knowledge construction. We are actually referring to learning in the workplace when we discuss knowledge seeking. Learning in the workplace has been called workplace learning or informal/incidental learning. As reviewed in previous chapters, however, the existing research has mainly focused on the special characteristics of, or the influential factors on learning in an organization, which is not about how individuals seek knowledge or learn in the workplace.

Other learning theories reviewed previously with regard to the learning in the workplace, namely experiential learning, action learning, and situated learning, have their different emphases. Situated learning theory places emphasis on the situation and circumstances and stresses the social relationships where learning occurs, which is mainly descriptive and shows the situated characteristics of learning. It does not go further to explain how we learn. Action learning theory also gives attention to the situation and circumstances and calls them 'learning sets'. It is argued in action learning theory that learning occurs through learning sets. Beside this, the core of action learning theory resides in the 'action'. As stated by Pedler (1997, p23), "there is no learning without action and no sober and deliberate action without learning". However, it is still not known how we take action and learn from it in this theory.

Experiential learning theory goes further than the other two theories in terms of how an individual learns. Four detailed steps of learning were identified in this theory, namely concrete experience, reflective observation, abstract conceptualization, and active experimentation. Learning occurs step by step in this cyclic process: we gain abstract conceptualization (namely knowledge) by reflecting on our concrete experiences, and then we use our knowledge by taking action: active experimentation, by which we gain concrete experiences again. Compared to the two previous learning theories, the experiential learning model provides us with more detailed steps that take place during the learning process. But it is still not known why active experimentation and how we execute it to gain experiences from it.

Action learning and situated learning theory both cover why active experimentation occurs but they do not explain how we take action, namely learn, in a certain situation or circumstance. According to the definition of situated learning given by Brown et al. (1989), learning involves a learner executing tasks and solving problems in an environment that reveals the various intended uses of the knowledge. From this sense, solving problems is the purpose of the intended uses of knowledge. This perspective is echoed in action learning theory, which is clearly displayed in its learning equation: ‘L (learning) = P (programmed knowledge) + Q (question)’. According to this, learning occurs in the action of finding solutions to problems in the workplace.

Based on the above discussion, the purpose of us executing active experimentation is to solve the problems we might meet during our work. We take action, namely active experimentation, intending to solve the problems. The active experimentation process is actually a problem solving process, by which we gain concrete experiences. Thus, the knowledge seeking process is not only an experiential learning process, but also a problem solving process.

4-7-1-2 Problem solving and information seeking

The review of the literature has shown the close relationship between information seeking and problem solving. During the information seeking process, problem solving is regarded as the underlying motivation (Wilson, 1999). According to Wilson (1999), a problem will cause uncertainty, whilst the move from uncertainty to certainty then becomes a goal of the problem solver, which can be regarded as goal seeking behaviour. The process of moving from uncertainty to increasing certainty is actually the problem-resolution process. In Wilson's information seeking models, information need is always seen as a trigger for information seeking behaviours.

A similar perspective can be found in many other information seeking research studies. In the first stage of Kuhlthau's (1991) information search process, 'initiation', a person is aware of the lack of knowledge and recognizes a need for information. In Foster's (2005) non-linear information seeking model, the 'orientation' process performs the basic problem solving aspects identified previously and then moves to the next process, 'opening', which refers to seeking and exploring information. In Dervin's (1983, 1998) sense-making theory, the 'situation' refers to the context from where a problem arises, and the 'gap' implies the differences between the existing situation and the desired situation, namely the problems.

Problem solving literature also pays attention to information during the problem solving process. For example, in 'preparation', the first phase of Wallas's (1926, in Zhong et al. 2010) problem solving process, the problem is defined and information gathered relevant to its solution. In Johnson's (1944) problem solving process, the first stage, 'orientation', refers to the information receiving function of mental activity. In Polya's (1954, in Zhong et al. 2010) problem solving process, 'understanding the problem' is to identify the problem's knowns (namely information given) and unknowns. In C'zurilla and Goldfried's (1971) problem solving model, ‘problem definition and formulation’ involves separating relevant from irrelevant information.

4-7-1-3 Preliminary framework for knowledge seeking

Based on the above discussion of the links among the literature and the definition given to knowledge seeking in this research, the knowledge seeking process is considered a knowledge construction process which consists of experiential learning, problem solving, and information seeking. The jigsaw links between these themes can be displayed in Figure 4-11. In experiential learning we take action to solve the problems we might meet and thus gain experiences, whilst during problem solving, we need to seek information. These three themes constitute the preliminary framework for knowledge seeking, which can now be added to Figure 3-2 (in p80), forming Figure 4-12.

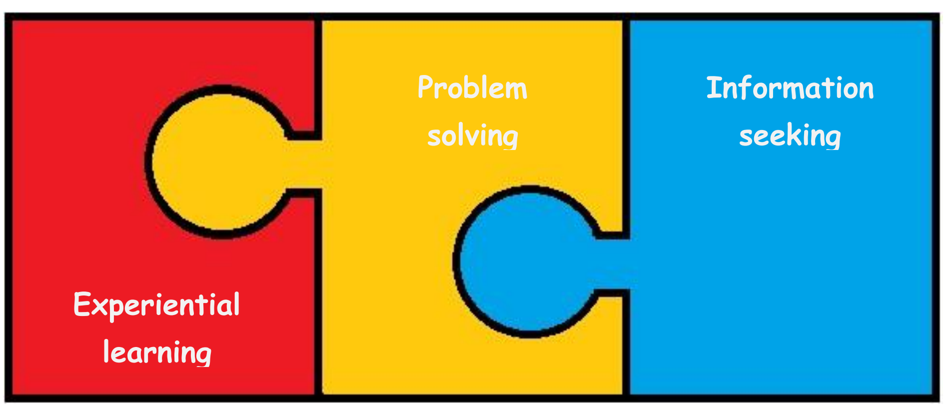


Figure 4-11: The jigsaw links between the themes

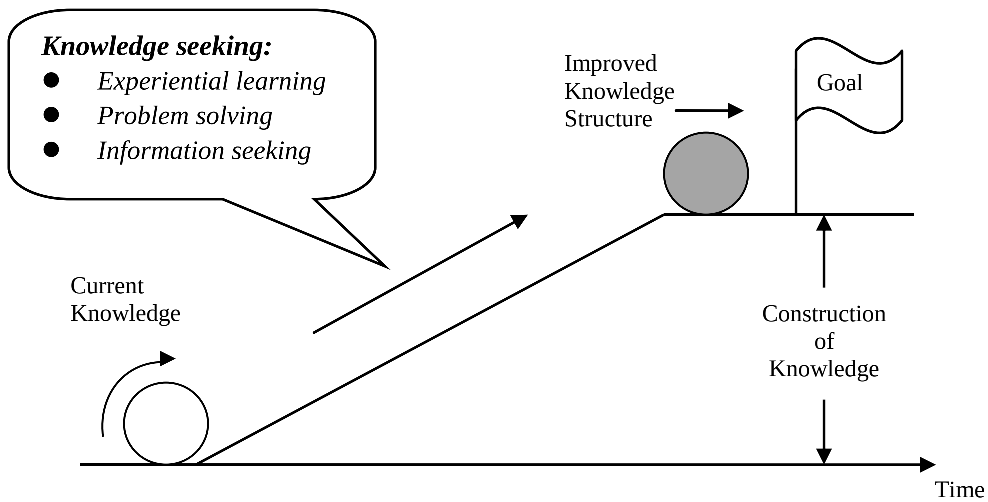


Figure 4-12: Knowledge seeking in a workplace

4-7-2 A Priori Codes for Knowledge Seeking

4-7-2-1 Information seeking process

Models of information behaviour are statements in the form of diagrams, which intends to describe an information activity, the causes and consequences of that activity, or the relationships among stages in information seeking behaviour. Based on the major information seeking models that have been reviewed, a comparison can be made among these different models. As shown in table 4-2, Wilson (1999) proposed three main stages in the information seeking process, whilst Foster (2005) proposed three cyclic stages. Ellis & Haugan (1989) and Kuhlthan (1991) proposed seven and six phases respectively.

Table 4-2: A comparison of information seeking process models

Resource	Information seeking process						
Wilson (1999)	***Primary need***	***Information need***	***Search behaviour***				
Foster (2005)	***Orientation***		***Opening***		***Consolidation***		
	Focus on identification and the direction to look. Reviewing, picture building, identifying keywords, source identification & selection, and problem definition. The key themes, keywords, latest opinions and recourses, and picture building can be identified.		Moving to actually seeking, exploring and revealing information. Open up their topics by breadth exploration, eclecticism, networking, keyword searching, and browsing, monitoring, chaining, serendipity.		Judging and integrating the work in progress and deciding if further information seeking is required, by refining, sifting, incorporation, verifying, finishing, and knowing enough. The stage loops and intertwines with Orientation and Opening processes in the context of inter-disciplinary research.		
Ellis Haugan (1989)	***Surveying***	***Chaining***	***Monitoring***	***Browsing***	***Filtering***	***Extracting***	***Ending***
	Generating ideas for new projects in the beginning of a project's life cycle	Connection or chaining between the different sources	Maintaining awareness of development, technologies for keeping up-to date	Scanning a wide range of sources, to find something of particular interest	Making the information searched as relevant and precise as possible	Working through sources to locate material of interest	Activities involved in finishing the information seeking process
Kuhlthan (1991)	***Initiation***	***Selection***	***Exploration***		***Formulation***	***Collection***	***Presentation***
	Be aware of a need for information. Seeking background information to identify possible topics and approaches.	Identifying and selecting the general topic to be investigated. Conferring with others, or skimming and scanning for alternative topics.	Exploring information to extend personal understanding. Reading to locate information about and understand topics, relating new information found to existing knowledge, and so on.		Identifying and selecting ideas from the new information. Topic becomes clearer and more personalized.	Gathering relevant information. Defining, extending the already personalized topic.	The search will be completed; the findings will be presented or be used.

Through a comparison of the stages of these different models, we can observe the similarities and major differences between them. For example, the information need in Wilson's model (1999) derives from primary need, while in Kuhlthan's (1991) model it is called 'Initiation' and refers to the awareness of the need for information. The 'selection' and 'exploration' in Kuhlthan's model refer to the identification of the topic to be investigated and the location of new information, whilst in Ellis and Haugan's model, similar activities have been divided into three steps, namely 'chaining', 'monitoring', and 'browsing'. 'Consolidation' in Foster's model refers to refining, sifting, verifying, finishing, and knowing enough. These five activities have been grouped into three steps in both Ellis and Haugan's model (namely 'filtering', 'extracting', and 'ending'), and Kuhlthan's model ('formulation', 'collection', and 'presentation').

As the purpose of this thesis is to explore the knowledge seeking process, the details of information behaviour is beyond this research. The steps developed by Wilson (1999) will be adopted, as this model does not demonstrate detailed information seeking behaviour but the major steps of: primary need, information need, and search behaviour. This is illustrated in Table 4-2 with shaded cells.

4-7-2-2 Problem solving process

Many process models have been developed. Roth and McGuinn (1997) categorize two different models in the literature: linear models and cyclic models, whilst Funke and Frensch (1995) arrange the theoretical developments in problem solving according to different traditions: the North American models and the European theories. Botia & Orozco (2005) use the molar and molecular categories to classify problem solving models.

The same comparison can also be made among these problem solving models as summarised in table 4-3. ‘Preparation’ in Wallas’ model is about defining the problem and gathering information relevant to its solution, whilst the nearly similar activity is named as ‘orienting to the problem’ in Johnson’s model, ‘general orientation’ in C’zurilla and Goldfried’s model, or ‘problem identification’ in Wilson’s model. In Polya’s model, ‘devise a plan’ aims to determine appropriate actions to take to solve the problem, whilst it is presented by two phases in C’zurilla and Goldfried’s model, namely ‘generation of alternatives’ and ‘decision making’. Verification in both Wallas’s model and C’zurilla & Goldfried’s model refers to checking if the resolution is correct, while in Polya’s model, it is presented by two phases: ‘carry out the plan’, and ‘looking backward’.

As problem solving is a major theme in knowledge seeking, more detailed steps are preferred in this research in order to avoid any omissions. In view of this, the steps from the models developed by C’zurilla Goldfried (1971) and Polya (1954) will be adopted into this PhD research (as highlighted in table 4-3), namely general orientation, problem definition and formulation, generation of alternatives, decision making, carrying out the plan, and looking backward.

Table 4-3: A comparison of stages in the problem solving process

<table>
<tr><th>Resources</th><th colspan="10">Problem solving process</th></tr>
<tr><td rowspan="2">Wallas (1926)</td><td colspan="2">Preparation</td><td colspan="3">Incubation</td><td colspan="3">Inspiration</td><td colspan="2">Verification</td></tr>
<tr><td colspan="2">Defines the problem, gathers information relevant to its solution</td><td colspan="3">Concerns about the problem at a subconscious level while engaging in other activities</td><td colspan="3">Gets a sudden insight into the solution of the problem</td><td colspan="2">Check if the solution is correct</td></tr>
<tr><td rowspan="2">Johnson (1944)</td><td colspan="4">Orienting to the problem</td><td colspan="3">Producing relevant material</td><td colspan="3">Judging or evaluative stage</td></tr>
<tr><td colspan="4">The organism grasps the material of thought and keeps it available for deliberation. Orienting toward something when the objects of thought are absent or abstract. In this sense, orientation is the receiving function of mental activity.</td><td colspan="3">A congeries of processes. The material may be produced by perceptual processes from the present situation, or may be remembered from the past, namely the memory or learning process, or may be communicated from others</td><td colspan="3">Select the alternatives from those elaborated. Claims relation between aspects of the problematic situation or the elaborated material which renders the situation less problematic, thus releasing the orientation.</td></tr>
<tr><td rowspan="2">Polya (1954)</td><td colspan="5">Understanding the problem</td><td colspan="3">Devise a plan</td><td>Carry out the plan</td><td>Looking backward</td></tr>
<tr><td colspan="5">to identify the problem’s knowns (givens) and unknowns</td><td colspan="3">determining appropriate actions to take to solve the problem</td><td>executing the actions</td><td>Evaluate overall effectiveness.</td></tr>
<tr><td rowspan="2">C’zurilla Goldfried (1971)</td><td>General Orientation</td><td colspan="4">Problem definition and formulation</td><td>Generation of alternatives</td><td colspan="2">Decision making</td><td colspan="2">Verification</td></tr>
<tr><td>General orientation or set in approaching a problematic situation.</td><td colspan="4">Defining the situation in "operational" terms; formulating or classifying elements of the situation to identify the primary goals, specify the major sub-problems, or issues.</td><td>To generate a number of possible solutions appropriate to the problem</td><td colspan="2">Make a decision to solve the problem.</td><td colspan="2">Implementation and outcome evaluation.</td></tr>
<tr><td rowspan="2">Wilson (1999)</td><td colspan="3">Problem identification</td><td colspan="2">Problem definition</td><td colspan="4">Problem resolution</td><td>Solution statement</td></tr>
<tr><td colspan="3">to answer what kind of problem it is</td><td colspan="2">To answer what exactly the nature of the problem</td><td colspan="4">To find out how we find the answer to the problem</td><td>The answer to the problem</td></tr>
</table>

4-7-2-3 Experiential learning process

In terms of experiential learning, according to Kolb (1984), previous 'concrete experiences' are the basis for 'reflective observations'. The reflections will then be assimilated and distilled to 'abstract concepts'. These abstract concepts have implications for new actions as guides and will be tested via 'experimentation', from which the new experiences will emerge. A new learning cycle then starts again. In this research, the four stages are all adopted, namely concrete experience, reflective observation, abstract conceptualization, and active experimentation.

4-7-2-4 A priori codes for this research

In qualitative research, themes are not hiding in the data waiting to be discovered, but arise from the researcher who attempts to address a particular research question. Based on above comparisons and discussions, a key set of a priori codes have been identified by the PhD researcher according to the research question of this thesis.

Table 4-4: A priori codes identified from literature

Themes:	**Problem solving**	**Experiential learning**	**Information seeking**
Codes:	General orientation	Concrete experience	Primary need
	Problem definition& formulation	Reflective observation	Information need
	Generation of alternatives	Abstract conceptualization	Search behaviour
	Decision making	Active experimentation	
	Carry out the plan		
	Verify the outcome		

As shown in Table 4-4, the codes emerge from the problem solving, information seeking and experiential learning processes as found in the literature. However, it has to be mentioned that, as stated by King (1998), the a priori themes should be acknowledged as tentative and subject to redefinition, revision or removal.

4-8 Chapter Summary

This chapter reviewed related literature concerning three major elements during the knowledge seeking process: information seeking, problem solving, and learning in a workplace, which provided us with understanding of how we seek information, what consist of the problem solving process, and how individuals gain knowledge in the workplace. This revealed the complex process of knowledge seeking in the workplace, which echoed the discussions of knowledge in KM in previous chapter: knowledge cannot be disembodied from people and thus acquired, coded, and stored somewhere else. Knowledge can only be actively learnt or sought by us.

More importantly, the jigsaw links among these three themes have been identified in this chapter, which constitute the knowledge seeking process: First of all, the knowledge seeking process is actually an experiential learning process, during which we gain knowledge by reflecting on our ‘concrete experiences’, then we use our knowledge by taking action, namely ‘active experimentation’, and then we gain experiences again. However, why active experimentation? and how do we execute it to gain experiences? ‘Problem solving’ answered this question: the purpose of us executing active experimentation is to solve the problems we might meet during our work. Thus the knowledge seeking process is not only an experiential learning process, but also a problem solving process. Secondly, there is also a close relationship between problem solving and information seeking. In much information seeking research, problem solving is regarded as the underlying motivation. At the same time, much problem solving research also pays attention to information seeking, as we need useful information to help us during the problem solving process.

Apparently, we gain experiences by solving the problem we might meet, while we need information to help us during problem solving process. Based on these findings from the literature, a preliminary framework for knowledge seeking has been developed which contains experiential learning, problem solving, and information seeking. Consequently, a key set of a priori codes have been identified from the related literature, which can be applied to the data analysis later on.

___CHAPTER FIVE___

Research Philosophy and Methodology

5-1 Introduction

The conventional reality that ‘people view the world differently’ underlines the inevitability of different approaches to research. Understanding the various theoretical perspectives of research methods assists the researcher in clarifying their research design. The aim of this chapter is to discuss the philosophical stance, research methods adopted in this research, and the approaches to data analysis conducted by the author. After a brief revisit of the research process and a clear statement of the aims of this research, the author’s understanding of research philosophy will be expressed including the three main paradigms: positivist, interpretive, and critical realism. Furthermore, the distinction between deductive and inductive research, and qualitative and quantitative research, will be discussed as well. Next, the research philosophy and methods adopted in this research will be stated with justifications, which is followed with a brief discussion of qualitative data analysis, particularly template analysis, as it has been employed in this thesis. At the end, the ethical issues of this research will be considered.

5-2 Revisiting the research process and research question

As an overseas student from China into the UK, the first barrier to overcome is cultural: the national cultural diversities. Because of an interest in knowledge management (KM), the central management topic throughout most of the world in the past 10-20 years, the author conducted an exploratory study in his Master's dissertation on national differences between the UK and China in developing a supportive culture for KM in organizations. The supportive culture investigated in that study was based on such organizational cultural attributes as trust, sharing information freely, team orientation, and working closely with others. This study introduced the researcher into KM and cross-cultural research.

The perspectives of psychology and cultural history argue that social differences existing among cultures affect tacit epistemologies and the nature of cognitive processes (Nisbett, et al, 2001). These national cultural differences may impact attitudes and behaviours during the process of knowledge related activities, e.g. knowledge seeking and sharing. Branch (1997) argues that particular features and functionality of KM systems are always based on their designers' or the managers' assumptions. These assumptions are inherent in the designers' or managers' cultural backgrounds. If the KM systems are utilized by those who have different professional or national backgrounds (from the designers or managers), the features and functionality designed for the system may actually inhibit the employment of it (Branch, 1997).

After talking with some managers who are working in multicultural organizations, the cross-cultural barriers and the knowledge behavioural diversities (knowledge seeking and sharing) among people in organizations from different countries were confirmed. As managers, how to deal with such cultural diversities to facilitate knowledge creation and effectively leverage knowledge is becoming a major problem in today's global economic environment. There is thus an apparent need to explore the national cultural impact on knowledge behaviours in organizations, in order to enhance knowledge creation and use for competitive advantage. As Pauleen and Murphy (2005, p22) state:

> ***"Information and knowledge management models that exclude the influence of national and regional culture seriously undercut their potential effectiveness, particularly in global applications."***

This prompted the researcher to propose a research project exploring cross-cultural influences on knowledge related behaviours. The aim of this research initially was to investigate how national cultural characteristics affect knowledge seeking and sharing behaviours.

After a review of the literatures on knowledge management and related areas, however, the researcher realised that, compared to knowledge sharing, knowledge seeking plays a more important role in knowledge management. Knowledge management activities will not likely be successful if they are based on a knowledge-sharing assumption alone. People actively seeking knowledge is the head of fountain of knowledge management. It is thus necessary to promote knowledge seeking rather than knowledge sharing for successful knowledge management. The researcher therefore decided to focus on knowledge seeking behaviours only. Then the research aim was aimed to the study of the impact of national culture on knowledge seeking behaviours. Based on this, a comparative study was proposed to identify the differences in knowledge seeking behaviours across different national groups.

However, in the area of knowledge management, research in knowledge seeking has been growing slowly (for example, Kankanhalli et al, 2004; Gebus & Leiviska, 2007; Sanjeev & Gee-Woo, 2005; Gray & Meister, 2004, 2005; Lin et al, 2006). In much of this research, knowledge is regarded as an intangible asset for organizations. Then they try to acquire, retain, share, and use knowledge by means of information technology within organizations. In this point of view, knowledge is actually the same as 'information'. The two concepts of information and knowledge are being used in a confusing or overlapping manner in much of the research in the KM field. More importantly, there was no clear statement, in the KM field, about what knowledge seeking is and what was involved in the process. Without a clear understanding of knowledge seeking or a framework about the knowledge seeking process, how can we compare it among different nations?

If we can make a clear understanding about knowledge seeking, and learn what happens in such process, then we can apparently improve this process and consequently enhance our knowledge management. At this point, this research determined to explore the knowledge seeking process, trying to understand this process by developing a knowledge seeking model in the workplace.

5-3 Understanding the philosophy of research

All research is based on some underlying assumptions, which determine what research methods are pertinent or how to conduct valid research (Myers, 1997), while the most appropriate philosophical assumptions are those relating to the underlying epistemology. According to Hirschheim (1992), epistemology refers to the assumptions regarding to what is knowledge and how we acquire knowledge. Burrell and Morgan (1979) pointed out that, to develop a philosophical perspective of research requires researchers to make several assumptions in relation to ontology (reality), epistemology (knowledge), human nature (pr-determined or not), and methodology. And these assumptions are significant to each other, namely, the view of ontology affects their epistemological persuasion, which will affect the view of human nature as a result. The assumptions we have made logically decide our choice of methodology.

Easterby-Smith et al (1997) explained how the understanding of research philosophy might help us in our researches. First of all, it can help researchers clarify the research method to be employed in study, namely the overall research strategy, including what evidence will be gathered, how they will be interpreted, and how they will answer the research question etc. Secondly, the understanding to research philosophy can help us in selecting or adapting appropriate methods for our research by evaluating different methodologies and methods, and help us identify the limitations and advantages of a particular approach in our research.

Table 5-1: Alternative names of philosophical paradigms (Hussey and Hussey, 1997)

Objectivist	**Subjectivist**
Quantitative	Qualitative
Positivist	Phenomenological
Scientific	Humanistic
Experimentalist	Interpretivist
Traditionalist	

As Hussey and Hussey (1997) stated, objectivism and subjectivism have long been explained as a continuum's polar opposites with varying philosophical positions associated with them. In the literature, these two assumptions have been labelled variously, such as positivism Vs phenomenology (Easterby-Smith et al, 1991), positivism Vs interpretive (Hughes and Sharrock, 1997). Table 5-1 adopted from Hussey and Hussey (1997) displays alternative names of philosophical paradigms.

As we may have noticed, the concept 'Paradigm' has now widely used in research, although Kuhn argued (1970) that there cannot be any paradigms in social sciences, but that social sciences are in a pre-paradigms phase in the development of scientific knowledge. As stated by Guba and Lincoln (1994), paradigm is a world view or a belief system that guides a researcher in their work. Actually this kind classification of different paradigms can also be found under some other titles in many methodology books, such as research philosophies, research traditions, or epistemologies. The classifications are various either in different books. For example, Guba and Lincoln (1994) suggested four underlying paradigms that frame social science research: positivism, post-positivism, critical theory, and constructivism, while Orlikowski and Baroudi (1991) suggested three categories: positivist, interpretive, and critical. Eriksson & Kovalainen (2008) even listed more: positivism, post-positivism, critical realism, interpretivism and constructivism, hermeneutics, post-modernism, and post-structuralism.

As Eriksson & Kovalainen (2008) argued that this disagreement of paradigms in research is due to the differences in the epistemological or philosophical positions of research settings, and some researches tend to follow the natural science model with hypothesis testing etc. Myers (1997) also pointed out that the distinctions among these paradigms are not always so clear cut in practice of social research. It is still arguable if these paradigms are necessarily opposed or can be accommodated within one study.

In the following, we will be briefly describing three common philosophical paradigms in research, namely the positivism paradigm, critical realism paradigm, interpretive and social constructionism paradigms.

5-3-1 Positivist paradigm

Auguste Comte (1898-1857) defined positivism as an assumption that the only legitimate knowledge can be found from experience (Eriksson & Kovalainen, 2008). The basic claim of positivism is that research produces facts and accounts, corresponding to an independent reality, is value free and prioritizes observation. The positivist paradigm focuses on objectivity, measurement and repeatability. It is premised on the existence of a priori fixed relationships within phenomena which are typically investigated with structured instrumentation (Orlikowski and Baroudi, 1991). In another word, they believe in empiricism, namely the idea that observation and measurement are the essence of scientific endeavour. Based on this, the knowledge of the world is obtained through applying the scientific methods to experiences and to empirical world (Eriksson & Kovalainen, 2008).

It is noted that much of Information System research reflects positivistic orientation (Orlikowski and Baroudi, 1991). Assumptions and hypotheses are developed and can be "verified" or "falsified". This enables replication of the study to different subjects, and the drawing of inferences and comparison. Positivism is fundamentally concerned with the view that true knowledge is scientific, in the sense of describing the coexistence and succession of observable phenomena (Bullock et al., 1988). It underlies what is called "the scientific method", the approach to research in the natural sciences, while it is not always suited to studying the social world, especially in IS research (Oates, 2005).

Oates (2005) concludes some characteristics of the positivist paradigm as in the following:

The world exists independently of humans: There is a physical and social world that exists "out there", not just in minds, to be studied, captured and measured (e. g. the law of gravity).

Measurement and modelling: The researcher explores this world by making observations and measurements and creating models (hypotheses theories) to illustrate how it works.

Objectivity: The researcher is neutral and objective, an impartial observer. Facts about the world can be discovered independently of the researcher's personal values and beliefs.

Hypothesis testing: Research is based on the empirical testing of theories and hypotheses leading to confirmation or refutation of them.

Quantitative data analysis: There is often a strong preference for mathematical modelling and proofs, and statistical analysis. The use of mathematics provides a logical, objective means of analyzing observations and results.

Universal laws: Research looks for generalizations that can be shown to be true regardless of the researcher and the occasion

5-3-2 Interpretivism and constructionism paradigm

As the positivist paradigm was developed for studying the natural world and is less suited to studying the social world, researchers have developed alternative research paradigms called the interpretive or constructionist paradigm. These approaches assume that researchers understand and interpret from their own frame of reference as they interact with the world around them (Orlikowski and Baroudi, 1991). Opposite to the positivist approach, reality is seen as socially constructed rather than objectively determined.

There are many forms of interpretivism and constructionism, but common to all of them is a concern with subjective and shared meanings, which are interested in how people interpret and understand social events and settings. According to Berger and Luckmann (1967), the philosophical foundation of interpretive and constructionist study is in hermeneutics and phenomenology, as they have an impact on the social construction of reality.

Interpretive research does not prove or disprove a hypothesis or theory, instead, they attempt to identify, explore, and explain how all the factors in a particular social setting are related and interdependent. As this kind assumption believe in that access to shared dynamic and changing and individually constructed reality is only through social constructions such as language and shared meanings, they tend to focus on not only the contents of empirical data, but also how these contents are produced through language practices. They also look at how the people perceive their world (individually or in groups) and try to understand phenomena through the meanings and values that the people assign to them. Based on this assumption, there might be many possible interpretations of the same data, and all of which are potentially meaningful.

In Information System research, the aim is to produce a rich understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context (Walsham, 1993). It tends to create an organized discovery of how human agents make sense of their perceived worlds, and how those perceptions change over time and differ from one person or group to another (Checkland and Holwell, 1998). Oates (2005) concluded the characteristics of the interpretive paradigm as in the following:

Multiple subjective realities: There is no single version of the truth. What researchers take to be real or knowledge is a construction of their minds, either individually or in a group. Different groups or cultures perceive the world differently.

Dynamic, socially constructed meaning: Reality can only be accessed and transmitted to others through social constructions (like language, shared meanings and understanding). These differ across groups and over time.

Researcher reflexivity: Researchers are not unbiased but subjective. The research process will inevitably affected by researchers' assumptions, beliefs, values and actions.

Study of people in the natural social settings: Not like most experiments in the artificial world of a laboratory, interpretivists' research is aimed at understanding people in the real settings, their own world.

Qualitative data analysis: for interpretivist researcher, they tend to have their own preference for generating and analyzing qualitative data. Some researchers can also use quantitative data collection like surveys in an interpretive way.

Multiple interpretations: Researchers will provide more than one explanation as there is not just one fixed explanation of what happens in the research.

5-3-3 Critical realism paradigm

Similar to the positivist paradigm, critical realism suggest that there is an observable world which is independent of individual consciousness. However, it is also accepted by critical realism that knowledge about the world is socially constructed. In other words, we actively construct knowledge based on the observable independent world. According to critical realism, the social reality is historically constituted and is produced and reproduced by people. However, as stated by Myers (1997), people's ability to consciously act to change their social and economic circumstances is constrained by various forms of social, cultural and political domination.

Critical realism research therefore focuses on identifying and challenging assumptions behind ordinary ways of perceiving, conceiving, and acting, recognizing the influence of history, culture, and social position on beliefs and actions, imaging and exploring extraordinary alternatives and being appropriately skeptical about any knowledge or solution that claims to be the only truth or alternative (Alvesson and Deetz, 2000). It aims at the oppositions, conflicts and contradictions in contemporary society, to eliminate the causes of alienation and domination. Interpretation and understanding are not enough, thus critical researchers seek to identify power relation conflicts and contradictions, and empowering people to eliminate them as sources of alienation and domination (Oates, 2005). As opposed to interpretivists, critical researchers tend to dominate their experiences and ways of authority and analyze the patterns of power and control that regulate and legitimize particular ways of seeing their world (Oates, 2005).

Guba (1990) pointed out that critical theories are tied intimately to the emergence of Marxism in the 19th century, although several terms are associated with this critical approach later on, such as neo-Marxism, materialism, the Frankfurt school, and Freireism. They all have links back to classical Marxism. Critical theory was built on the foundation of Marxism by those who thought the classical Marxist theory was not sufficient to deal with the complex social and economic structure of modern societies. As the major focus of critical approach is the analysis of data through the lens of an ideology, Guba (1990) regarded it as a kind of ideologically oriented inquiry.

5-4 Deductive versus inductive research

A discussion of research methodology would not be complete without mentioning how to bring forward knowledge about the world in research. According to Eriksson & Kovalainen (2008), there are two basic models of social science research, namely deductive and inductive research methods.

Deductive research is defined by Hussey & Hussey (1997, p.19) as:

> ***"a study in which conceptual and theoretical structure is developed which is then tested by empirical observation; thus particular instances are deducted from general inferences".***

This approach rests on the assumption that theory is the first source of knowledge, and suggests that we can deduce one or more hypotheses based on what is known about a phenomenon theoretically. It is also called 'top-down' approach, working from the more general to the more specific, like a waterfall from the existing theory to hypothesis, to observation, and to confirmation. This type of inquiry can typically be found in most quantitative studies where a theory or a hypothesis is tested via experimental designs and surveys. As stated by Eriksson & Kovalainen (2008), in this approach, the certainty in theory development is gained through the hypothesis testing in empirical scrutiny.

However, an inductive research involves the development of theory from observation of reality, “thus general inferences are induced from particular instances” (Hussey & Hussey, 1997, p.19). Induction suggests that theories can be seen as corrective mode concerning findings or even publications that come forward during the research process (Johnson & Duberley, 2000). Compared to deduction, inductive reasoning works like hill-climbing from specific observations to broader generalizations and theories. The research process in this approach starts from empirical materials rather than theoretical propositions. So it is also called ‘bottom-up’ approach. The conclusion of research is thus likely on the basis of premises, involving a degree of uncertainty. This inquiry is typically qualitative often deriving from a grounded theory approach to research.

5-5 Qualitative and quantitative approaches

Among the discussions of research approaches, there is another kind of classification of research approach that should be discussed, namely quantitative and qualitative research approaches, which have often been associated with their respective positivist and interpretivist approaches. Without mentioning this pair of method the discussion of methodology would not be complete.

According to Myers (1997), Quantitative research methods were originally developed in the natural sciences to study natural phenomena. It inherently involve experiments and surveys aimed at testing hypotheses, using large samples of data and numerical methods, such as mathematical modelling, in attempt to find ‘cause and effect’ relationships – the positivist approach. Alternatively, qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomenon (Myers, 1997). In qualitative research method, like case study, grounded theory, narratives, and ethnographic studies, the researcher are often directly involved into the phenomenon under study. Qualitative data normally collected from observation, interviews, documents and texts, etc. compared to quantitative research methods, qualitative methods aim to help us understanding a social phenomenon from the participants' perspective and its social and institutional contexts, which tends to be lost in quantitative data. Holloway and Wheeler (2002) have summarised the differences between qualitative and quantitative research in detail, which is displayed in Table 5-2.

Creswell (2003) pointed out that qualitative and quantitative methods should not be seen as being exclusive to each other, and suggested mixed methods, such as interviews and observation combined with surveys. As stated by Silverman (2001), both qualitative and quantitative methods are valid approaches, and it is no use to emphasise on the polarities of them. Hussey and Hussey (1997) argue that the employment of these two methodologies in a single research may add richness to findings and may be helpful to triangulate. The similar discussions of triangulation have been echoed in Markus' (1994) and Mingers (2001).

According to Creswell (2003), the researchers not only select different research approaches like qualitative, quantitative or mixed, but also decide on a type of study along with the choice of these approaches. *Strategies of inquiry* are these types, which provide particular direction in research design (Creswell, 2003). According to him, the strategies for a quantitative study include experimental designs, and non-experimental designs (such as survey). The experimental designs seek to discover whether a particular treatment influences an outcome, whilst the non-experimental designs present numeric description of trends, opinions or attitudes by means of investigating the target sample.

Table 5-2 : Qualitative and quantitative research (Holloway, Wheeler, 2002)

	Qualitative	**Quantitative**
Aim	• Exploration of participants' experiences and life world • Understanding, generation of theory from data	• Search for casual explanations • Testing hypothesis, prediction, control
Approach	• Broad focus • Process oriented • Context-bound, mostly natural setting • Getting close to the data	• Narrow focus • Product oriented • Context free often in artificial or laboratory setting
Sample	• Participants, informants • Sampling units such as place, time and concepts • Purposive and theoretical sampling • Flexible sampling that develops during research	• Respondents, participants • Randomised sampling • Sampling frame fixed before research start
Data collection	• In-depth non-standardised interviews • Participant observation/fieldwork • Documents, photographs, videos	• Questionnaire, standardised interview • Tightly structured observation • Documents • Randomised controlled trials
Analysis	• Thematic constant comparative analysis • Grounded theory, ethnographic analysis etc.	• Statistical analysis
Outcome	• A story, an ethnography, a theory	• Measurable results
Relationships	• Direct involvement of researcher • Research relationship close	• Limited involvement of researcher • Research relationship distant
Rigour	• Trustworthiness, authenticity • Typicality and transferability	• Internal/external validity, reliability • Generalisability

The qualitative strategies, however, include narrative research, phenomenology, ethnographies, grounded theory, and case study (Creswell, 2003). For example, in ethnography, the researcher studies in a natural setting over a period of time by collecting observational and interview data. For grounded theory, the researcher attempts to derive a theory of a process, action or interaction grounded in the view of participants. According to Creswell (2003), the mixed method strategies include sequential mixed methods, concurrent mixed method and transformative mixed methods. In this strategy, it is believed that knowledge does not fall into one philosophical reality, and the researcher may decide how knowledge can be 'best' derived. For example, in the sequential mixed method, it may begin with a qualitative interview for exploratory purpose, followed by a quantitative survey to generalise results to a bigger population. In concurrent mixed method, the quantitative and qualitative data are converged or merged to provide a comprehensive analysis of the research question.

5-6 Research philosophy and method adopted in this research

5-6-1 Research philosophy & approach

As discussed previously, the positivist philosophy is based on the approach used in the natural sciences, assuming that social reality is independent of human perception, which exists regardless of our awareness of it. In another word, permanent laws exist in the social systems and that these laws can be extracted and analysed in isolation from the social system itself. Thus, this approach suggests that there are facts about the social world that can be collected and analysed independently of the people from whom the facts were obtained. Research under this philosophy are thus commonly associated with a quantitative research approach, and seek to measure variables of interest quantitatively and the quality of the research is normally assessed by means of statistical measures of reliability and validity.

In contrast, an interpretivist/phenomenological research philosophy seeks to understand human behaviour from the participant's own frame of reference, arguing that social reality is on the basis of our subjective minds, is determined by their social setting, namely, is 'socially constructed'. Based on this, as a researcher, we should seek to understand and explain phenomena in a particular context rather than seek universal laws attempting to explain them outside of any localised setting. Therefore, an interpretivist/phenomenological research tends to be characterized by focusing on the meaning that research subjects attach to social phenomena, and what the researcher attempt to understand what is happening and why it is happening is fundamental for a research. Research under this philosophy are thus commonly associated with a qualitative research approach, and seek to examine and reflect on perceptions by means of observation and interviewing the participants in order to gain an understanding of social and human activities.

The aim of this PhD research is to understand the knowledge seeking process in the workplace as mentioned previously. This aim has informed us what we are trying to explore and what we should pay attention to in the research, namely the perspectives or behaviours of the knowledge seekers, and the context of the knowledge seeking process in the workplace. As have identified in the objectives in Chapter One (p15), the objective of collecting primary data is for the understanding of knowledge seeking process, and to develop a theoretical model conceptualizing knowledge seeking that integrates key elements of the process. Therefore this research will be conducted on the basis of the participant's perspective in line with the contextual understanding. An interpretivist/phenomenological philosophy is underpinning this PhD research. Based on this research philosophy and the research aim, a qualitative approach, namely in-depth interview, will be employed to achieve the research goals, as this qualitative approach will help us understand a phenomenon and its particular social and cultural context, which will be lost when data are quantified. The following section will further discuss how a qualitative approach is designed, how qualitative data will be collected through time-line interviews for this research, and how the data will be analysed in both deductive and inductive ways.

5-6-2 Sense-making theory as a methodological guide for research design

In information seeking behaviour research, Dervin's (1983) sense-making theory has been regarded as a kind of methodology as having been discussed in previous chapter. As both internal and external behaviour, sense-making helps people construct or design their movement through time-space. According to Dervin's (1983), when people perceive that they are facing a situation in a particular time and space, they are able to construct a temporary ordered reality, which will guide their behaviour. However when the situation (space, time etc.) is changed they will behave differently. This theory thus focus on how individuals construct their pictures of reality and consequently to guide their behaviours.

According to Dervin (2003), the core assumption that sense-making theory is based on is the discontinuity, which implies that there are discontinuities in all existence, including entities, times, and spaces. This discontinuity exists among the whole chain of the sense making process: from the reality to human sensor, mind, tongue, message created, channel selected to communicate, and so on. It also exists between the one individual but at different time, or between different people at the same time, and so on. Based on this, information is then conceptualised as the sense is created by human beings at a specific time, and a specific space. Information is thus something that exists among human behavioural activities. Therefore, information seeking and use should be a constructive process rather than a simple transmissive one.

From this perspective, research in information seeking and use should focus on the information seeker themselves. We should ask questions in a user-oriented way, and then the data collected will be able to reflect the way they construct or make the sense. Furthermore, as it is the behaviours or step-takings that help information seekers and users to construct sense of the world, sense-making theory is then focusing on users' behaviours, which might be either internal such as comparing, categorizing, liking etc. or external such as attending, listening, agreeing, etc.

In 1998, Dervin reviewed Sense-making theory in terms of its implication for knowledge management. Knowledge and information were conceptualized as a verb, and were considered not to be different for each other in this theory. Whatever name they might be called – data, information, or knowledge – they are 'product of fodder for sense making or sense unmaking'. This development could justify the employment of sense-making theory for knowledge seeking behaviour research in this thesis. The following will explain the research method adopted in this research under the methodological guide of sense-making theory.

5-6-3 Sense-making interview: structure and questions

Many empirical studies have been conducted employing sense-making theory especially in the 1980s and 1990s. In information science, sense-making theory has been employed to discover and capture information users' perceptions. In practice, the core technique of the sense-making approach is time-line interviewing, which is derived from anthropology, ethnography, and psychology (Schamber, 2000). Schamber (2000) argues that time-line interview provides a temporal framework for users by help them recall their cognitive states at certain times during certain situations.

The interview involves a series of open-ended questions administered in a structured way by the researcher. According to Dervin (1983), time-line interviews are normally conducted in three steps: In the first step, the respondents are asked to describe their situations as sequences of events step by step, such as what happened first, and then second, etc. All the events are then able to be outlined, which are called time-line events. This is followed by asking the respondent for more detail about each event to indicate any questions, puzzles, or confusions within each event. Consequently, this leads to the third step to discover what information he/she needed to find for answering those questions; and whether or how this information helped them. A series of specifying questions are asked in the third step to reflect the dimensions of 'situation', 'gaps', and 'outcomes'. This process continues through all time-line steps. In this way, the three dimensions of the sense-making model, situation-gaps-uses, can be identified in order to understand why and how people seek and use information.

In the interview, the respondent is asked to reconstruct different situations, based on their real experiences. As recollections of real experiences can be guided by the researchers with different research purposes, it is possible to focus on different elements. This has resulted in some derivative interviewing methods, such as ‘Abbreviated Time-line Interview’, ‘Helps Chaining Interview’. For example, Abbreviated Time-Line Interview (Dervin, 1992) is aiming to focus on only one step of question, help, or barrier, which is especially helpful in research situations involving routine or habitual behaviour. In another derivative interviewing method, Helps Chaining Interview (Dervin, 1992), it emphasizes on how the respondent constructs the connection between information, system, or structure and self, which involves repeated queries to the respondent of ‘how did that help you’.

Table 5-3: Interview structure and questions

Step one: Introduction of the interview

- Self-introduction (name, job, working experiences)
- A brief of this research: aim, objectives, reasons, significances.
- Consent to interview

Step Two: Situations

- Anchor respondents to a real task
- Ask respondents to list what happened step by step

Step three: Gaps and helps (loop questions)

- Focus on each step separately
- How do you think about this situation?
- What problem did you meet?
- What actions did you take to solve the problems?
- Why did you take this action?
- How did the actions help you solve the problems?
- Any supplementary questions to above.

Step four: Conclusions

Referring to Dervin's (1983) structure of the use of this interview technique, the research structure and questions in this research have been developed as in Table 5-3.

In this study, in order to anchor respondents in terms of a real life situation, the contextual situation is set as follows. When the target person in an organization receives an assignment, which he is not able to solve by his current knowledge structure, how will this person 'seek knowledge' to have his current knowledge structure improved in order to meet the knowledge gap and fulfil the assignment? In practice, the participants will be asked to recall a typical task they had accomplished at work. The respondent will then describe in detail each step or situation they experience in the process of completing the task. In this process, the author will record time-line steps on a card, which will be reminding him to ask the detailed questions in each time-line step later. This will also help to establish sequential pictures of individual situations.

Next, the interview then turns to focus on all micro-moments when the respondents saw themselves as 'encountering a problem': what problem did you met? How did you think you can solve this problem? From where did you seek help or information? Did you get any information? Did they help, and how? What experience did you get by solving the problem? What knowledge did you gain through your experience? All these questions were designed to reflect the other two elements, 'gaps' and 'helps' of the triangle sense-making model.

After the interview structure and questions are drafted, pilot interviews were then conducted with 5 respondents from the researcher's acquaintances. It has drawn the researcher's attention to the fact that the questions could not reflect very well in terms of how the respondents' knowledge is gained from the process. As the data collected from these pilot interviews mainly shows the process how people complete a task, and how they find useful information to help them. However, during this process, most of the steps or actions the respondents took are just routines of their work, which does not reflect any increases in their knowledge base. So the data collected is not able to display a good picture of how they seek knowledge in a workplace.

Table 5-4: Revised interview structure and questions

Step one: Introduction of the interview
• Self-introduction (name, job, working experiences) • A brief of this research: aim, objectives, reasons, significances. • Consent to interview
Step Two: Situations
• Anchor respondents to a real situation by asking: Could you recall anything happened to you during your work, from which you think you have learnt a lot, or you think you got knowledge from it?
Step three: Gaps and helps (loop questions)
• Asking questions step by step from the very beginning • Why do you think you have learnt a lot from it? • What was the situation at the very beginning? • How did you think about this situation? • What problem did you meet? • What actions did you take to solve the problems? • Why did you take this action? • How did the actions help you solve the problems? • What have you learnt from it? • Any supplementary questions to above.
Step four: Conclusions

As stated by Dervin (2003), in different research genres, sense-making should be focused on different elements depending on the research purpose. Based on this, the researcher decided to revise the question in order to focus on the knowledge seeking process, namely, how the respondents seek knowledge in a real situation. The revised interview structure and questions are in the following (Table 5-4).

Again after the introduction of the interview, the purpose was to anchor respondents in terms of a real life situation. But the question has been revised as: Could you recall anything happened to you during your work, from which you think you have learnt a lot, or you think you obtained knowledge? This question will pull the respondents directly into a real situation of his knowledge seeking experiences. Similarly, the next step will go into the details of this situation to explore what happens in this situation. But the question will focus on 'knowledge', which could give top priority to what we are concerned with rather than the working task completion process.

5-6-4 Identifying the target sample

In qualitative research, the sampling process is normally decided by the methodological approach employed or the research topic. According to Marshall (1996), there are three major sampling approaches: convenience sample, judgement sample, and theoretical sample. In this PhD research, convenience sampling and judgement sampling were used.

As an international PhD student initially attempting to conduct a cross-cultural research among different nations, approaching voluntary participants for the research is quite a difficult task. So convenience is always the first choice. Furthermore, considering the purpose of this research: knowledge seeking process, knowledge workers from knowledge intensive industry (named by Drucker, 1966) are supposed to be the proper sample due to its nature. Bearing these two points in mind (convenience and knowledge workers), construction engineers were selected as the target sample after the researcher contacted some acquaintances in the construction industry. Although the research aim had been adapted later on from cross-cultural research to exploring individual knowledge seeking process, a brief review of the literature concerning knowledge management and the construction industry still justified the choice: construction engineers in China. As argued by Crookes & Davies (1998), purposive sampling (or judgemental sampling) refers to the conscious choice by the researcher of certain topics or elements in the research.

According to Drucker (1999), the most valuable assets of a company in 20th century was its production equipment, while in 21st century is its knowledge workers and their productivity. Construction engineers are this kind of knowledge worker. As in a project-based industry, professional knowledge has been regarded as the core competitive advantage for surviving in the construction industry. As argued by Kamara & Augenbroe (2002), the failure to capture and transfer the professional knowledge may increase the risk of impaired project performance. Effective management of knowledge in the organization will help them address the need for innovation and improved business performance and client satisfaction (Kamara & Augenbroe, 2002).

According to Dave and Koskela (2009), each construction project can be considered a multidiscipline organization which may or may not continue to work together once the project completed. This implies the temporary nature of construction. Furthermore, another characteristic about this industry is the huge number of companies that exist. For example, in the UK, there are about 163,000 construction companies and most companies have no more than eight employees (Egan, 1998). This has been recognised as another major characteristic of this industry: fragmentation.

The temporary nature of construction and fragmentation makes construction a very complex process, which results in poor efficiency of the overall process (Dave and Koskela, 2009). For example, in the report of the construction task force to the Deputy Prime Minister of the UK, John Egan (1998) listed the need to improve the construction industry in the UK. The challenges included the need to modernise, client dissatisfaction, and fragmentation.

To face with the challenges, Ribeiro (2009) argues that construction firms must learn to gather, share, and reuse project knowledge, and lessons learned from previous projects, since the “individuals and the knowledge they create are the most critical features for improving business performance and ultimately collective learning” (Ribeiro, 2009 p281). Furthermore, Hall and Spased (2005) argue that, in project-based firms, it is critical and a valuable capability to capture, share and transfer knowledge that resides with senior professionals. As stated by Dave and Koskela (2009, p896), “in this context knowledge management has been viewed as a strategy to promote innovation and enable improvement of the construction process”. According to them, if the knowledge, created from the construct project, can be captured and reused, the process efficiency will be improved, and the waste reduced.

According to Dave and Koskela (2009), however, this knowledge is mainly stored in the project team members’ minds and is not efficiently transferred in the organization for reuse in future project. “Due to heavy fragmentation, the industry as a whole is not able to capture and share knowledge via a common platform. Valuable knowledge is being lost as a result" (Dave and Koskela, 2009 p897). Similar perspectives can also be found from Ribeiro (2009), who argues that it has proven a rather difficult challenge in practice to transfer knowledge within the construction industry; and Obaide & Alshawi (2005), who argue that it is a key challenge to enable corporate knowledge to be captured and shared, and to use this knowledge to enhance the efficiency and effectiveness of construction business.

According to Chen and Mohmed (2006), there are limited numbers of empirical studies on KM in construction firms. Furthermore, Ribeiro (2009) argues it is still unknown from research studies and the related literature how to enhance the sharing and exchange of organizational knowledge harboured by senior professionals working in the construction industry. This indicates the lack of studies concerning knowledge transfer in this industry, let alone knowledge seeking research.

In view of the nature of construction engineers and the construction industry, and the research need from the relevant studies, construction engineers were convincingly justified as the target sample in this PhD research. Through contacting industry contacts, the researcher approached target interviewees in China, who are architecture engineers from the construction industry. According to Dervin (1983), the timeline interview based on Sense-Making theory is to investigate individual sense making process. So studies based on Sense-Making theory are supposed to be based on the perspective of the actor rather than the perspective of the observer. As a consequence, the data collection in this research is then mainly based on the individual interviewing. Even so, some contextual information of the engineers has also been collected by the researcher through the interviews and some informal talking with the participants.

These participants were from four different organizations located in three different cities: three private Architecture design corporations and one government owned architecture design institutions. One of the organizations is The Urban Planning and Design Academy, an institution affiliated to local Municipal Commission of Urban Planning and responsible for the formulation of various city plans. They provide services for the city's macro decision-making on city development and construction projects, which includes the formulation of the city master plan, district plan, regulatory plan, infrastructure plan, the transportation plan of the municipality, and so on. The other three organizations are architectural design corporations, which mainly provide architectural design services for the construction market.

Participants' tasks mainly cover urban planning and architectural design. Although they are different companies and from different locations, they have a lot in common as they are from the same industry and their businesses are mainly to provide design services. In practice, clients establish their need for a construction project and develop a set of requirements. These requirements are delivered to these architectural companies who will draw up a set of designs to meet the requirements. Once approved, the drawings will be sent to the construction company and be transformed into the facility for the use of the client. The details of the engineers and their job roles will be presented in Chapter Nine.

In addition, the snowball technique was also employed among the initial interviewees in this PhD research, which helped to find more participants. In the end, 26 interviews were successfully conducted among the participants. All interviews conducted were audio-recorded and transcribed by the researcher.

5-7 Data analysis method

5-7-1 Qualitative data analysis

In fact, the whole process of qualitative research can be confusing and frustrating, as it is difficult to get the 'right' answer from so many possible answers. To the quantitatively oriented researchers, it tends to take them out of their comfort-zone when they look at things from a qualitative perspective. For these researchers, particularly in the past, qualitative analysis was like a 'black box': some data went in, and some findings came out, and there was no real concern as to how the researcher arrived at those findings from their opinion.

When considering qualitative data analysis, the first question that needs to be clarified is how to understand qualitative data. According to Miles & Huberman (1994), in some sense, all data are qualitative, and they refer to essences of people, objects, and situations. Normally, most qualitative research focus on data in the form of words, namely, language in the form of extended text, although qualitative data can also appear as images, videos, etc. Qualitative data has some key strength, one major feature of which is that 'they focus on naturally occurring, ordinary events in natural settings' (Miles & Huberman, 1994, p10). In other words, qualitative work is focused on exploring events as they occur naturally, and grounded within the context. This also ensure that qualitative data is naturally featured with richness and holism, which means its strong potential for revealing complexity by providing 'thick descriptions' nested in a real organizational context.

These characteristics of qualitative data consequently have impact for the way we should think about qualitative analysis. The strengths of qualitative data allow analysis to really get to grips with the underlying meanings and layers of the social world. Therefore, we should try not to strip the entire context away when we analyze the data. Furthermore, the richness of qualitative data can make our findings really compelling to the readers, although we might also get lost in it, which should be recognized at the same time.

According to Miles & Huberman (1994), qualitative analysis consists of three concurrent flows of activity. The first step is data reduction, which is defined by Miles & Huberman (1994, p10) as 'the process of selecting, focusing, simplifying, abstracting, and transforming the data'. Namely, this is to reduce the rich data set down to its core idea. The second step is data displays, which refers to an organized, compressed assembly of information that permits conclusion drawing and action. This may be simply as selections of text like quotes, or as charts of graphs. Whatever, qualitative displays are like a forum for creativity in analysis, which should help understand the data set. Finally, it is the drawing of conclusion and verification after reduction and displaying, which is basically the process of deciding what the data means.

5-7-2 Template analysis

Template analysis, also named as codebook analysis or thematic coding, is a very widely used method in qualitative analysis, which focuses on the themes or particular aspects of the data (King, 1998). The essence of this approach lies in the explicit use of codes as the starting point of the analysis process. A list of codes or a template are defined or constructed a priori, based on prior research, theoretical perspectives, or preliminary scanning of the text (Miles & Huberman, 1994). Then, it is applied to the later data analysis when the researcher reads and interprets the text. According to King (1998), the template analysis can be regarded as being within a middle ground between content analysis and grounded theory. In a grounded theory there is no a priori definition of codes at all, while in a content analysis, codes are normally predetermined and will be applied to the text to generate quantitative data for statistical analysis. Compared to content analysis, the initial codes or template is to be revised in the light of the ongoing analysis by being applied in the text.

As have mentioned previously, a deductive approach is also called 'top-down' approach, working from the more general to the more specific. From this sense, template analysis is a deductive approach at the beginning, as it normally starts with selected pre-defined codes, namely the initial template, ideally based on the interview topic guide. Once an initial template is constructed, the researcher must systematically work on the full set of texts on the basis of research aim, which will be able to develop the template to its final form, by revealing the inadequacies in the initial template, and making various kinds of changes to find out more appropriate codes for the template. According to King (1998), the changes made in this process may include insertion, deletion, changing scope, changing classification, and so on. From this sense, template analysis becomes inductive, as the data analysis turns to the development of theory from observation of reality. "General inferences are induced from particular instances" (Hussey & Hussey, 1997, p19)

This template analysis approach is adopted in this PhD research. Considering the research aim, namely understand individual knowledge seeking process, the unit of analysis of this study is each individual rather than a group or an organization. More specifically, due to the employment of the time-line interview, the unit of data analysis could be each 'micro-moment' during an individual knowledge seeking process.

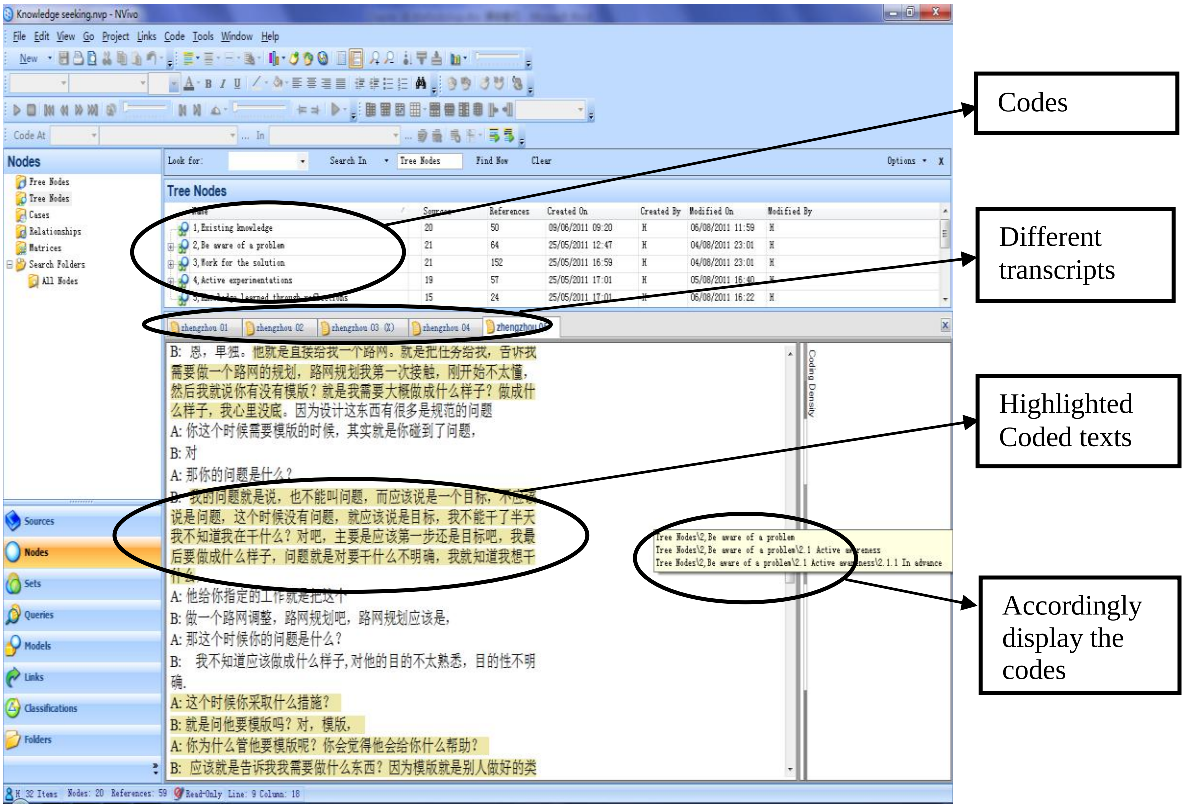


Figure 5-1: The layout of Nvivo for data analysis

The software ‘Nvivo’, as a powerful qualitative data analysis tool, is employed. In the first step of data analysis, all the audio-recorded interviews are transcribed into text format (See the transcripts of interview one in Appendix B & C). Then in the next step, all these transcripts data are entered into the Nvivo database. As the smart design of the software, the transcripts can be easily coded, organized, and displayed (as shown in Figure 5-1, also in Appendix D: an example of the coding from the transcripts). The a priori codes developed from the literature (see table 4-4 in p146) are applied to the first transcripts. Based on the a priori codes and the first transcript, an initial template is constructed.

After that, this initial template will be applied to the other transcripts for further data analysis, until a final form can be achieved (See a picture of the coding tree in Appendix E).

As stated by Crabtree and Miller (1999, p177), this approach makes "the coding tree and coding the text relatively quick, reproducible and easy to grasp for those skeptical of qualitative research". It is especially suitable for the quantitative oriented researchers to take the first step into qualitative analysis.

5-8 Ethical considerations

Ethical considerations are very important when conducting qualitative research. Strict procedures relating to ethics should be considered. In making use of interviews for the purpose of research, a number of ethical issues must be adequately dealt with, which include: confidentiality, truth telling, informed consent and keeping promises (Johnson, 2002).

When contacted with the target organizations, the researcher explained the background and the aim of this research and the possible time an interview might take. Once research access was granted by the institutions, the suitable time to conduct interviews were arranged. At the commencement of each interview, it was vital to maintain a reasonably open mind and to be truthful with the respondents, as any suggestions that I was being less than honest in anyway could cause the respondents to be more closed and reduce the extent of their openness. Therefore, each interview commenced with exchanges aimed at establishing a good relationship with the respondents and giving them background information about the research and about myself.

After that, a consent form for the interview was signed by the participant (See a sample of the form in Appendix A). The respondents were assured that all correspondence would be treated in strict confidence although it would be audio- recorded, and where necessary.

This essentially had the effect of making some respondents more relaxed and willing to express their thoughts without fear of consequence. The need to repeat the issue of confidentiality was very important, seeing that all the interviews were being documented through audio recording. As Warren (2002, p91) expressed "not only might turning on a tape recorder alter the ensuing conversation, but the meanings of audio- or videotaping may be different to different respondents", audio-recording may cause the respondents to be extremely cautious in their speech. As a result of this, from the start of each interview and before the audio recorder was brought out, the issue of strict confidentiality was explained to each respondent. Permission was also sought for the use of the recorder with the accompanying explanation of how no one else would have access to it and how it would make `my work much easier'.

In addition, it should be pointed out that no children under 18 years of age old participated in the research. Neither was monetary or other rewards offered to any participant or respondent in this research.

5-9 Chapter Summary

All research is based on some underlying assumptions which determine our research method. As the concept 'Paradigm', as a world view or a belief system that guides a researcher in their work, has now widely used in research, this chapter described the major philosophical paradigms, namely positivism, interpretivism and critical realism. Considering the aim of this research is to explore the knowledge seeking process in the workplace, an interpretivist philosophy is underpinning this research, which seeks to understand human behaviour from participants' own frame of reference. Based on this philosophical assumption, a qualitative approach has been employed as well, during which sense-making theory has been employed as a methodological guide for the research design. According to Dervin (1983), sense-making as both internal and external behaviour, helps people construct or design their movement through time-space. Therefore, the time-line interview method has been employed to collect qualitative data in order to help us understand how people behave in a particular time and space.

In order to collect primary data, construction engineers have been identified as the target sample. As a project based industry, construction engineers are knowledge workers who need intensive knowledge to complete different construction project. Knowledge seeking happens during their daily life in the workplace. Through industry contacts, the researcher approached target interviewees in China. After that, template analysis and Nivivo software have been utilised to assist data analysis in this research. As a very widely used method in qualitative analysis, template analysis focuses on the themes or particular aspects of the data, which is characterised by the explicit use of codes at the starting point of analysis process. The next chapter will illustrate how the data is analyzed and interpreted in detail.

___CHAPTER SIX___

Interpretation and Discussion of the Study

6-1 Introduction

According to King (1998), the essence of the template analysis approach is to produce a list of codes (that is, a template), representing themes identified in the textual data, which can lead to produce an interpretation of the text. This chapter presents the results of the template analysis from the interview data from the construction engineers. After a brief description of the interviewee, the themes emerging from the data and the a priori codes derived from the literature will be discussed and presented. These formed the basis of the initial template produced from one interview transcript. This initial template was further developed when applied to the other transcripts. The revised template will then be presented that describes the knowledge seeking process in the workplace.

6-2 A brief description of interviewees

As shown in Table 6-1, 26 construction engineers from four organizations located in three different cities have participated in this research. All interviewees' name have been anonymized and coded. All quotations will be translated from the Chinese by the researcher.

In the Urban Planning and Design Academy, there are two kinds of engineers being interviewed. One kind of engineers is 'Urban Planning Engineer' (UPE), who is mainly responsible for the planning of a city. Their job is to map out a plan for a city, particularly for new urban areas or the redevelopment of existing urban areas, to enhance the multiple functions of a city under the 'City Planning Law of China' and related planning regulations or codes of a city, in order for a rational layout and a unified planning with consideration of local conditions. The other engineer interviewed in this organization is the 'Road Design Engineer' (RDE), who is mainly responsible for the planning and design of the traffic or roads in a city. Their job is to map out a city's road networks and the design of the roads for construction under the 'Code for Design of Road'. (Job roles displayed in Table 6-2)

In the other three architecture design companies, there are mainly four different kinds of engineer being interviewed: Architecture Scheme Engineer (ASE), Construction Design Engineer (CDE), Structural Design Engineer (SDE), and Building Service Engineer (BSE). These different engineers have different duties in the architecture design process. The ASE is responsible for sketching the building according to client briefings to meet the client's requirements. The ASE normally works together with the CDE, SDE, and BSE in a coordinative way to fulfil a whole building design. Compared to the ASE, the other

Table 6-1: A profile of interviewees

Ref No.	Gender	Years of Working	Job	Organization	Location	Interview Date
ZZ01	M	4	BSE	Architecture design corporation	Zhengzhou	Nov.2008
ZZ02	M	2	RDE	Urban planning and design academy	Zhengzhou	Nov.2008
ZZ03	F	2	RDE	Urban planning and design academy	Zhengzhou	Nov.2008
ZZ04	M	6	UPE	Urban planning and design academy	Zhengzhou	Nov.2008
ZZ05	F	2	RDE	Urban planning and design academy	Zhengzhou	Nov.2008
ZZ06	M	4	UPE	Urban planning and design academy	Zhengzhou	Nov.2008
ZZ07	F	5	SDE	Architecture design corporation	Zhengzhou	Nov.2008
ZZ08	M	3	CDE	Architecture design corporation	Zhengzhou	Nov.2008
ZZ09	F	5	CDE	Architecture design corporation	Zhengzhou	Nov.2008
ZZ10	M	4	ASE	Architecture design corporation	Zhengzhou	Nov.2008
ZZ11	M	3	ASE	Architecture design corporation	Zhengzhou	Nov.2008
ZZ12	F	4	BSE	Architecture design corporation	Zhengzhou	Nov.2008
ZM01	M	4	ASE	Architecture design corporation	Zhumadian	Jul.2009
ZM02	M	6	SDE	Architecture design corporation	Zhumadian	Jul.2009
ZM03	M	6	SDE	Architecture design corporation	Zhumadian	Jul.2009
ZM04	M	2	SDE	Architecture design corporation	Zhumadian	Jul.2009
ZM05	M	2	ASE	Architecture design corporation	Zhumadian	Jul.2009
ZM06	M	2	ASE	Architecture design corporation	Zhumadian	Jul.2009
ZM07	M	1	ASE	Architecture design corporation	Zhumadian	Jul.2009
ZM08	M	2	BSE	Architecture design corporation	Zhumadian	Jul.2009
ZM09	M	2	SDE	Architecture design corporation	Zhumadian	Jul.2009
ES01	F	5	BSE	Architecture design corporation	Enshi	Jul.2009
ES02	M	3	SDE	Architecture design corporation	Enshi	Jul.2009
ES03	F	1	BSE	Architecture design corporation	Enshi	Jul.2009
ES04	F	2	SDE	Architecture design corporation	Enshi	Jul.2009
ES05	M	2	SDE	Architecture design corporation	Enshi	Jul.2009

RDE: Road design Engineer; UPE: Urban planning engineer; ASE: Architecture Scheme engineer
CDE: Construction design engineer; SDE: Structural design engineer; BSE: Building services engineer

engineers work on the concrete construction of a building. The CDE is responsible for working out the ‘working drawing’ of the building according to the architectural scheme from ASE. The SDE is responsible for working out the construction structure of the designed building, while a BSE is mainly responsible for the design of water supply & drainage, and fire protection system. (Job roles displayed in Table 6-2)

Table 6-2: Descriptions of typical job roles

Organization	Job title	Typical job description
Urban Planning and Design Academy	**RDE** (Road design engineer)	To map out a city’s road networks and the design of the roads for construction.
	UPE (Urban planning engineer)	To map out a plan for a city, particularly for new urban areas or the redevelopment of existing urban areas, to enhance the multiple functions of a city in order for a rational layout and a unified planning.
Architecture Design Corporation	**ASE** (Architecture Scheme Engineer)	Responsible for sketching the building according to client briefings, fulfilling a whole building design to meet the client’s requirements.
	CDE (Construction Design Engineer)	Responsible for working out the ‘working drawing’ of the building according to the architectural scheme from ASE
	SDE (Structural Design Engineer)	Responsible for working out the construction structure of the designed building
	BSE (Building Service Engineer)	Responsible for the design of water supply & drainage, and fire protection system

Typically, once the company gets involved in a construction project, a project team will be established including different specialised engineers, such as ASE, SDE, and BSE, CDE. The ASE will get a ‘Design Specification’ from the client in the first place. They may also contact the client to learn more detailed requirements of the building. Then the ASE will work on the schematic design of an architecture, which may includes different kinds of drawings, such as elevations, plans, and sections. Once the schematic design is approved by the client, the other engineers will work together to complete the architecture technology design, including structural design by a SDE, building service design by a BSE, and working drawings by a CDE.

Furthermore, there is normally a chief engineer in each organization, who is responsible for supervising all construction projects. Once the engineers from a project team have completed their design for the project, they will send the drawings to the chief engineer in the company for inspection. After that, the drawings will be sent to local department of government, 'Construction Administrative Committee', for approval.

6-3 Themes emerging from the interview data

An initial review of the interview transcripts provided some impressions about the knowledge seeking process. These impressions echoed the three themes involved in the process, namely experiential learning, problem solving, and information seeking.

First of all, when the interviewees were asked to recall what made them gain knowledge, without any exception, all the interviewees mentioned the work tasks or projects they completed during their activities. According to them, it is such work experience that makes them gain knowledge. This positively responds to Kolb's (1984) experiential learning theory, which argues that learning is the process whereby knowledge is created through the transformation of experience. Similar to what is proposed in experiential learning, the interviewees learnt the meaning of their immediate concrete experiences by internally reflecting on apprehended experience and thus extending it. Furthermore, the new extended apprehension will stimulate the internal reflections and feelings again. Based on this, learning takes place through this active extension by grounding ideas or experiences in the external world, and through internal reflections about these ideas and experiences. It is apparent that the knowledge seeking process is actually an experiential learning process.

Another impression emerging from the interviews is in problem solving. All the interviewees mentioned the problems they encountered during their work tasks or projects. Encountering a problem meant they were not able to complete their tasks on the basis of their existing knowledge base. In other words, their existing knowledge could not solve the problem they met. Consequently, they had to find a solution to the problem, and the way they solved the problem is actually the way they learnt. Through problem solving process, they gained experiences and knowledge which was new to them. The knowledge seeking process appears naturally to be the basis of problem solving.

The third impression relates to the knowledge seeking process. In order to solve the problem to complete their tasks or projects, the interviewees tended to search for more related information to assist them working out the solution, or seek help from others to get a resolution directly. As argued by Dervin (1983), when people perceive that they are facing a situation in a particular time and space, they are able to construct a temporary ordered reality, which will guide their behaviour. When the engineers faced a problem, or found a gap in their knowledge, they would seek information to come out of such situations and to arrive at new situations, to face gaps, and to build bridges across those gaps, evaluating the outcomes and moving on. So it seems that the information seeking process is naturally involved in the knowledge seeking process.

As has been proposed previously, knowledge is special and is not a kind of product which can be found from somewhere or from someone directly. So knowledge seeking is not like seeking something from somewhere, but a complicated learning process. The impressions confirm this proposition and the main themes involved in the knowledge seeking process as suggested in previous chapters (see figure 4-12). The knowledge seeking process is actually a knowledge construction process consisting of experiential learning, problem solving, and information seeking. In the following sections, the analysis has been conducted on the basis of the three themes in order to develop the knowledge seeking process model.

6-4 Producing the initial template

According to King (1998), template analysis normally starts with a few themes, which will help to guide analysis, to accelerate the initial coding phase of analysis. These themes are usually referred to as ‘a priori’ themes. In order to develop such a priori theme, a comparison of different process models from literatures with regard to information seeking process and problem seeking process has been made in previous chapter (Table 4-2, and 4-3 in Chapter Four). Based on the comparison, some a priori codes have been identified from the literatures (see table 4-4 in Chapter Four). These codes will be applied in to some transcripts to develop an initial template.

King (1998) argues that, after a priori themes are identified and interviews are transcribed, the next step involving the initial coding of the data. Based on the coding, an initial template can then be produced. However a key issue here is when this initial template can be drawn up on the basis of just one transcript or should it be done on every transcript. As argued by King (1998), in most studies, the initial template is produced at a point between the two extremes. In this study, an initial template was produced on the basis of the first transcript. The interviewee, ZZ01, is a senior engineer in a construction company, who is in charge of water supply and heating installations. The following section presents how the initial template developed.

6-4-1 The start of knowledge seeking process

The interviewee, ZZ01 was asked by a client to fix the ‘temperature-control’ system in a building. Although he replied yes to the client, “*I had totally no idea about it at that time … to be honest I had not got any clue at that time*”. For ZZ01, this project presented a problem that he had to resolve in order to make money. But how did he realize that this was a problem for him?

As discussed in previous chapters, ‘knowledge’ incorporates many intangibles such as experience, intuition, judgement, skill and lessons learned, which have the potential to improve actions (Henczel 2001). When ZZ01 was faced with a project or a goal, the first thing he tended to do was to find out if he was able to complete the project, to achieve the goal. At this point, he used his current or existing knowledge to analyze the project he was going to complete. As he stated, “*I was not specialized in this area, and never did this kind of job before*”. When he found him that he was not able to complete the project or task based on his existing knowledge base, what we called the knowledge seeking process was initiated. This means that ZZ01 had to ‘seek knowledge’ to improve his actions in order to solve the problem and complete the task: “*I can only do it by myself, to study, to explore by myself*”. This can be illustrated in Figure 6-1.

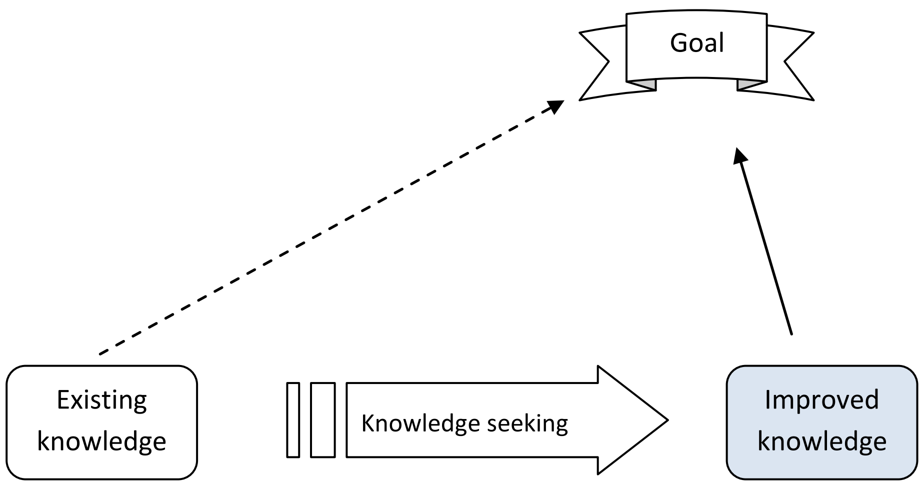


Figure 6-1: The start of the knowledge seeking process

As shown in Figure 6-1, the broken arrow line between the 'Existing knowledge' and the 'Goal' indicates that ZZ01 was not able to complete the project and achieved the goal based on his existing knowledge. The solid arrow line between the 'Improved knowledge' and the 'Goal' implies ZZ01 was able to complete the task and achieved the goal. The arrow box between the 'Existing knowledge' and the 'Improved knowledge' shows this knowledge seeking process. It was such a project that triggered the following knowledge seeking processes.

6-4-2 General orientation

When he was asked to carry out the task, ZZ01 was placed into a situation that is called 'general orientation' (C'zurilla and Goldfried, 1971). As the first step for the problem solving process, 'general orientation' refers to an individual's general orientation or set in approaching a problematic situation. ZZ01 realized that there was a problem for him to achieve the goal in the first instance and, as stated by C'zurilla and Goldfried (1971), he accepted the fact that problematic situations constitute a normal part of life and that most of these situations can be handled effectively:

> *"This was a big project for me at that time…We need jobs to earn money…so I replied him yes and said that I would come and have a look at it…"*
>
> Furthermore, ZZ01 decided to
>
> *"Do it by myself, to study, to explore by myself".*

6-4-3 Problem definition and formulation via information seeking

In order to work out the solution, ZZ01 reported that the first thing he did

> *"Was to look for references or data from library…to learn the fundamental principles first… I contacted the company to ask more details about the system, the problem, and their requirements… I went to the company to meet their engineers who is in charge of the system…they might not know how to solve the problem, but they know more than me about the system. From the library I mainly learn the theoretical aspects of the job, while from the engineers I can learn the practical aspects of the system."*

Once he decided to find out the way to solve the problem, the next step ZZ01 took was to look up references in the library and from other engineers in the client company. All he did was try to find out useful information which could help him to work out the solution. This phase required defining all aspects of the situation in "operational" terms, and formulating or classifying elements of the situation appropriately, so that relevant information could be separated from irrelevant information, the primary goals could be identified, and the major sub-problems, issues, or conflicts specified. According to Wilson (1999), problem solving is the underlying motivation for information searching. A problem will cause uncertainty, while the advance from uncertainty to certainty will then become a goal of the problem solver, which can be regarded as goal seeking behaviour.

6-4-4 Generation of alternatives

After he looked for and read the references from library, and chatted with the engineers from the company, ZZ01 worked out solutions theoretically by himself, as he stated that:

> *"Basically, after I learnt from library, and chatted with the engineers, I would say I had learnt a lot. At least, theoretically, I have got some ideas in mind".*

According to C'zurilla and Goldfried (1971), the generation of alternatives includes identification of a number of solutions to the problem. The major task here is to generate possible solutions appropriate to the problem identified previously. ZZ01was asked to fix the 'temperature control' system in the building, which means the problem is the 'temperature-control'. He had to find out a way to solve this problem even if only theoretically in the first instance.

6-4-5 Decision making

Once alternative solutions are worked out, the problem solver will have to make a decision which option can be applied to solve the problem, such as whether or not a particular solution would resolve the problem, or whether it was feasible, etc. This requires that the consequences of the solutions must be considered and judged. ZZ01 worked out a solution and reported back to the company for their approval. He stated:

> *"As I have got plan or ideas in my mind, they agreed to give me the job".*

Because he provided a solution to the problem, ZZ01 got the job from the company. In other words, it was the company that agreed ZZ01's plan and decided to employ him to solve the problem.

6-4-6 Active experimentations

ZZ01 remarked that

> *"They agreed to give me this job. The next was to complete my plan, to do what I think in my mind".*

In the problem solving process, there is a step called 'carry out the plan' or 'verification', which refers to executing the actions that have been determined to solve the problem and checking their effectiveness. In the experiential learning process, a similar step is called 'active experimentation'. It means that the solution or plan worked out in the previous step will be tested via experimentation. This is the stage where we take action to solve the problem according to the solution in our mind.

6-4-7 Concrete experience

After the plan is carried out, there are normally two different results against the original goal: success or fail. If the problem is solved, successful experiences will be gained. However, concrete experiences will still be gained even if the active experimentation is a failure. At this point, the original problem may still exist, waiting to be solved. Alternatively, some different, new problems might emerge. For example, ZZ01 stated that the plan,

> *"... was not difficult for us, and we just installed the equipment according to what I designed, what I thought in my mind before. After we installed everything, we began to debug the system. And we found this problem: the temperature is too low..."*

Apart from this, ZZ01 encountered another problem:

> *"… the temperature sensor: Where should it be installed? I had no idea about it before…"*

In these circumstances, the new problems have to be faced and new ways to solve them found in order to achieve the original goal. This would lead to a return to the previous step, 'general orientation', and a new cycle will be started. This cyclic process will not stop until all the sub-problems are solved and the original goal is achieved.

6-4-8 Reflective observations

ZZ01 commented on the importance of 'analysis' based on experiences after the experimentation, which helped him to learn, to seek knowledge, especially by analysing the failure:

> *"… in our work, we will normally try different ways to solve a problem. You may find the final solution after you fail many times. Every time you fail, you could learn from it. Even if you were wrong, you can still get knowledge from it. As said by someone, we should analyze the failure more than successes, because the ways to success might be the same while the ways to failure are definitely different. Once we analyze our experiences, whatever success or failure, we gain knowledge."*

As the problems were solved and the original goal was achieved, concrete experiences had thus been gained. Based on these newly extended experiences, internal reflections and feelings were stimulated and consequently, the meaning of immediate concrete experiences was learnt. As Kolb (1984) argued, learning takes place through this active extension by grounding ideas or experiences in the external world, and through internal reflections about these ideas and experiences. Furthermore, the reflections will then be assimilated and distilled to abstract concepts, that is, what we normally called 'knowledge'.

6-4-9 Summary of the initial template

Based on the literature and the first transcript, an initial template was developed. In this template, the trigger of the knowledge seeking process is presented. Furthermore, the following phases in the knowledge seeking process was identified, namely general orientation, problem definition and formulation through information seeking, generate alternatives, decision making, active experimentations, concrete experiences, knowledge improved through reflective observations (see figure 6-2). The next step in a template analysis is to develop the 'template', which will be presented in detail in the following sections.

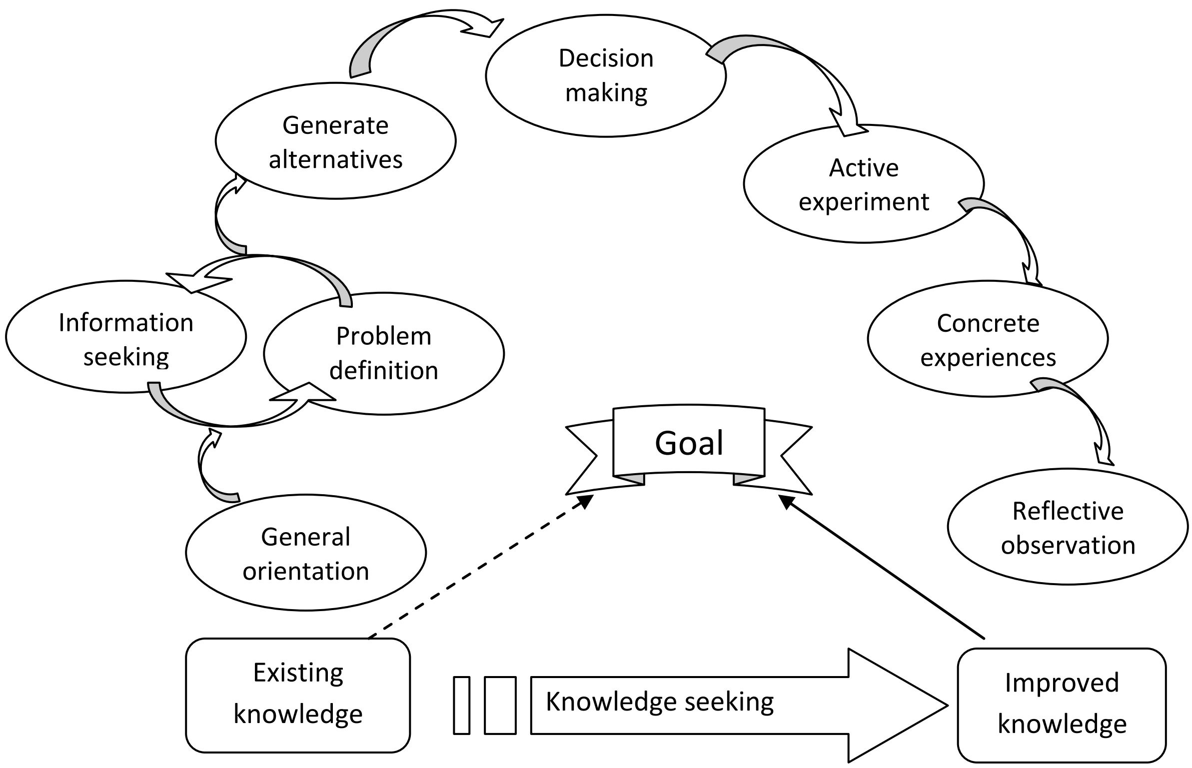


Figure 6-2: The initial template of the knowledge seeking process

6-5. Development of the template

Once the initial template is produced, the next task is to develop it by applying it to other transcripts in turn. During this phase, 'inadequacies in the initial template will be revealed' (King, 1998, p125). Various types of modification might be made, such as insertion, deletion, changing scope, changing higher-order classification, etc. In this research, the initial template was applied to the full set of transcripts to develop its final form. Some of the steps in the initial template were renamed, removed, or changed to ensure it described the step clearly.

6-5-1 Existing knowledge

The initial template has explored the start of the knowledge seeking process, namely to commence a project. However, this explanation is not able to display how an individual's knowledge will be improved through the knowledge seeking process. A new code, 'existing knowledge', has been introduced to help us understand the knowledge situation of the engineers before they commence a knowledge seeking process.

Look back at ZZ01's knowledge situation before his knowledge seeking process initiated, he described his knowledge situation as follows:

> *"One day, I received a phone call from a big company and was asked if we are able to do the temperature-control for the central heating system of their office building .... Actually, I had totally no idea about it at that time as I was not specialized in this area, and never did this kind job before."*

Obviously, the existing knowledge situation of ZZ01 at the very beginning is that he knew nothing about this kind of project.

ES05 talked about what happened to him when he was just newly employed:

> *"… it was structural design for a 7-story building. As I just graduated from university, I did not know very much about this kind project. Although I have learnt some basic knowledge about it from university and knew some basic process to do such a project, I never practiced in a real project … the next is to design the reinforcement of the building. It is actually a matter of the ratio of reinforcement. There are pillars, beams, and cast-in-place concrete plates. All of these need reinforcement design. But I had no idea about it at that time…"*

When ZZ09 graduated from university and was employed by the construction company, he did not know very much about his work although he had learnt a lot from university:

> *"As I just start work at that time, I had no experiences. I had no idea what aspects should be taken into account to deal with this kind project… fire prevention is a big aspect for building service design. Nobody taught me how to do with it so I had no idea what aspects I should consider during this project. When I was in the university, I never did a project like this … even during placement, our job were normally very easy, not as difficult as this project…"*

ES01 has been working as a BSE for several years in the construction industry, so she knows a lot in her area, although it is not enough for her to solve the new problem:

> *"…my job is mainly to design building water supply and drainage systems, and the design of fire protection for the buildings … we normally use a special software, PKPM. But its main duty is for building structural design. Water supply and drainage design is an accessory function of this software. So it is not as good as other exclusive software for water supply and drainage design, especially for outdoor drainage designs… after I got the project I asked for more information I needed. Because I know I can start my design only if the detailed information is provided such as the level of the water supply and the level of the sewer ditch. If the differences between them are too small, I will have to promote the level of water supply in order to drain the water away… I have known a lot about the water supply and drainage design, especially these basic principles in this area…"*

Understanding the extent of their existing knowledge base is important for these engineers as they start a knowledge seeking process.

6-5-2. Be aware of a problem

In the formulation of the initial template, it seemed to imply that being faced with a new task triggered a knowledge seeking process. However, as other interviews were analysed, it became apparent that being faced with a project or task is not necessarily a trigger for knowledge seeking, as we may be able to fulfil the task easily in our own way. In other words, we may not be aware of any problem when we implement a project or task. In such circumstances, the knowledge seeking process will not be triggered as we are able to complete the project based on our existing knowledge. Only when we realize there is a problem to complete a project, will a knowledge seeking process be triggered. Thus, being aware of a problem during a project is the trigger of a knowledge seeking process in the workplace, not the task or project itself.

Looking back to the interview transcripts in developing the initial template, ZZ01 was asked to complete a task. At that time when he was informed the task, ZZ01 realized that the task was a problem for him, as he realized that he '*was not specialized in this area, and never did this kind job before*'. However, situations from other interviewees were not always the same as this. Many people did not realize there were any problems when they started a project or task. They became aware of a problem when undertaking the project, or sometimes they did not realise there was any problem until someone else pointed it out to them after they had completed the task in their own way. Different ways of being aware of a problem have been identified, which have been coded as: Active awareness, Passive awareness, and Discussion with others.

A. Active awareness

Active awareness refers to the situation when we become aware of a problem actively on our own. It may happen right after we get the task but before we start doing it, or it may happen whilst we are doing the task. These two different situations have been coded as 'Active awareness in advance', and 'Active awareness during a project'.

When we get a project, we will normally evaluate the project based on our existing knowledge. Then we are likely to be aware of any problems immediately. As what happened to ZZ01, when he was asked to do a project, he actively realized it was a problem for him:

> *"Actually, I had no idea about it as I was not specialized in this area, and never did this kind job before…to be honest, I had not got any clue at that time".*

The same situation also happened to other interviewees. For example ES01, a BSE, talked about her first time to design the water supply and drainage system outside a building:

> *"there was a project including the design of the water supply and drainage system outside a building. I never did this kind design before, as what I did was mainly about the system in a building rather than outside".*
>
> *"…But I did not practice a lot. I have done some structural design during my study in University, but never practiced it in a real project. This project was my first structural design for a real building". (ES05)*
>
> *"When I was assigned this project, nobody told me what I should do as they probably thought I could do it by myself. Actually, I did not. I knew this was a problem for me…in the first place I was not familiar with the Codes. You know, as an architecture designer, it is very important to do our job according to the Codes. You will not know how to do it if you are not familiar with the Codes…the second problem for me was I was not sure the requirements of our drawings…they had gave me some information about the requirements of drawings but I was still not sure. This is mainly because I never did this kind job before, and I did not know it". (ZZ02)*
>
> *"the major problem for me is about the planning. You know we have lots of Codes. There are different codes for different aspects, such as codes for the allocation of*

public resources, codes for land use, etc. We should take all these factors into account and then decide how to plan the land and allocate the public resources, such as whether a primary school is needed there. Therefore we need to learn the codes first, then we can decide how to plan the land…I did this kind land planning before, but each project is different as the local situation is different, and the client's requirements are different as well. So we still encounter some problems, such as how to define the volume of construction, the height of the building there." (ZZ04)

'our team leader gave me a task, and asked me to do a planning of road network. This was the first time for me to plan a road network … I even did not know what exactly I was going to do. I had no idea about the goal of the task.' (ZZ05)

'I designed high-rise buildings before, but this one is different. It is an out-of-codes high-rise building. To design the structure of this kind building, we are asked to do additional calculations via special software, which I never did before and am not familiar with …, there are two problems: first of all, I did not know how to do an out-of-codes high-rise building; secondly, I never used that special software before. I know nothing about the software.' (ZZ07)

'the problem is I never did this kind project before, and feel nowhere to start' (ZZ10)

'there are two major problems. The first one is about the design of a composite steel structure for a building. I never did this kind project before, although I knew a little bit of it. I only did a part of steel structural design before, but it was not like this one, which is a composite steel structure, and I will have to do the whole project on my own … another problem is about the steel joints in the steel structural design. Which kind of joint is better for a certain connection? Steel structural design is different from concrete structural design. There are lots of different joints to connect different parts in a steel structural design, you will have to decide which kind joints is more suitable, and easier to construct, while I do not know these very well. For example, the connection between a main girder and a side bar, which kind joint is suitable, hinged connection, rigid connection, or others?' (ZM03)

'the project was designing a library, a kind of public building. When I was assigned this project, it was really a challenge for me … the major problem is that this is a design of a library, and I never did this kind building when I was in University. We learnt to design different kinds of buildings in university such as residential building, office building, hotel, etc. but did not know about library or hospital, which are more complicated than other kinds of building.' (ZM06)

'my job in that project was allocated to make some readjustments about the scheme, as an architecture scheme normally needs some small adjustments when take construction working into account. This kin adjustment require us a good understanding and master of the Codes. As I did not know much about the Codes for high-rising building, this project was a really challenge for me.' (ZM07)

These interviewees were aware of a problem actively even before they started doing their project. However, there are some other kind ways of being aware of a problem in the interviewees, being coded as 'actively awareness during a project.' The interviewees may still encounter some new problems or a sub-problem after they start doing the project. Namely they may realize a problem during they are doing a project. For example: a new problem might be realized when we are trying to find a solution to an old problem, or when we are experimenting our solutions. Anyway, we might be aware of a problem at anytime during a project.

ZZ01 realized a problem before he started the project. However, after he solved the problem and during his doing the project, he found a new problem:

> *'we still got some problems … the problem was the temperature. The temperature was too low …it should be 25 degree, but it was only 15 degree … another problem is the temperature sensor. Where should it be installed? I had no idea about it.'*

Some other interviewees were faced with new problems once they started their projects:

> *'I checked my design over and over, and against the Codes. I finally found some problems. It was about the slope of the sewer. It is stated in the Codes that the slope angle of the sewer should be less than 15%. When I found this rule from the Codes, I checked my designed immediately …I did not know this rule before. I found this rule when I reviewed my design against the Codes' (ES01)*
>
> *'I spent the whole afternoon to design but found something wrong with it. Some pipes were put in a wrong place. Then I had to change my design and did it again' (ES03)*
>
> *'Once I started the project, I realized that I had no clue about the size of structural elements in a real situation. For example: a girder. How long or how big should it be? I had no clue about it … when I started drawing the design via the software I found I did not know the tools of the software very well especially about the 'loading calculation', which is to calculate the weight of the wall. I had no idea how to do with it … Later on, I got some problems with regard to the use of the software, such as some parameter values, what the Windows default value is? I was not sure … I got two problems: I was not familiar with the drawing in the first place; the second problem was about the optimization of the reinforcement. I was not sure how to do the reinforcement economically, safely, and complying with the Codes.' (ES05)*
>
> *'I got some other problems, but they were not that big, not conceptual or ultimate problems. They were mainly from technical aspects.' (ZZ05)*
>
> *'I got some technical problems when I was doing the project, which was about the connection between different constructional parts … it was a glass curtain wall which should be installed outside the building and connected to the wall of the building. It*

thus became a problem for me about how to connect the glass curtain wall and the wall of the building. As there was a small gap between the two walls, this gap became the problem due to the consideration of fire protection. How should I deal with the gap then? I had no idea' (ZZ09)

'On the contrary, this brought new problems for us. I calculated the minimum capacity of the building fire pool according to the Codes. But it was too big to fit for the basement. The basement was a triangle, so the usage rate of the space was comparatively low. Furthermore, the client wanted a storage area and a garage in the basement, therefore the space in the basement was really scarce. If the capacity of the fire pool was designed as I had calculated, there would be no space for the storage area and garage in the basement. At the most, it could only accommodate an equipment room there, which obviously did not meet the requirement of the client. You know, as business men, the developers always require more available space.' (ZZ12)

B. Passive awareness

In A above, whenever the engineers realized there was a problem, in advance or during a project, they became aware of the problem actively. They are aware of a problem when they are placed in a real situation based on their existing knowledge. That is, they found the problems by themselves. However, on many occasions, the engineers are not aware of any problems. Or they are probably aware of some problems, not others. They come to realize a problem only after someone else points it out, or reminds them. This kind situation has been coded as 'Passive awareness', as the engineers are not able to find out about the problem by themselves. Again, this passive awareness could be in advance or during a project.

For example, ES01, a building services engineer, who got her first project to design a sewerage system outside a building, actively realized the challenge for her as she had never done such an outdoor project. However, she was not aware of any specific problems until she was reminded by another engineer.

> *"… The problem was about an intercepting ditch. As this was my first project, I was not able to realise this problem. When I went to his office to take the project files, our chief engineer reminded me to pay attention to this problem … an intercepting ditch is used to prevent the runoff water from a hill running into the residential area by intercepting them into a ditch. As it was an outdoor project and there was a hill over there, the runoff water from this hill became a problem especially when it rains. I never designed any intercepting ditch before. How could I realize such kind problem? … As for designing such a intercepting ditch itself, it was not difficult as it was similar with many other kinds of sewerage ditch which I knew well. But this awareness was really important. I would have never considered planning such a ditch if the chief engineer did not remind me …"*

Obviously, it was the other engineer that helped ES01 to be aware of the problem. ES01 found this problem passively. This kind of situation happened to the interviewees very often, although most of them were passively aware of a problem not in advance of starting a project but during doing a project. Again, we may have a look at what happened to ES01. After ES01 completed her project, the design was sent to the construction department. However, the construction department had no idea of how to build the manhole.

> *"They came and asked me. I did not know either at that time. I just knew there should be a manhole, but I did not know how to build it. As a designer, I thought I should give the builder as much help as I can. Although I did not know the specific construction method, I decided to help them to find out the solution …"*

Take ZZ02 as an example, who is a road design engineer. He took part in a big urban planning project and his task was allocated to design a road as a part of such a big project. After he finished the draft design based on his existing knowledge, ZZ02 send his work to the chief engineer for approval. The chief engineer pointed out some problems existing in his design:

> *"our chief engineer pointed out some problems that I had to solve in my design … for example, there was a problem about the U-turn. You know, it was a dual-carriageway. A central reservation had been designed along the road, which continued for quite a distance. In this circumstance, any vehicles from the side road can only turn right to join the main traffic. As I did not design any U-turn point on the road, if the vehicles want to go left they will have to travel along a very long way to get a U-turn. You*

know, I had not much experience when I did that project. I did not realize the inconvenience for the vehicles if there was no U-turn point on the road, until our chief engineer pointed out this problem for me."

This kind of passive awareness of a problem during a project happened to many interviewees.

"Our chief engineer pointed out some problems for me, for example the design of the stairs ... he told me that the design of the stairs was unreasonable ... actually the design itself is ok, no problem, which complies with the Codes. However, the location of the stairs was not in accord with the pedestrian flow from an overall perspective, which might delay the evacuation of people when accident happens …" (ZZ08)

"I remember once I worked on a project, a six-story building. The ground and first floor are shopping malls, and the rest of the floors are residential. I thought my design was fine then I sent it for approval. However, there were still many problems being detected. The chief engineer pointed out some problems for me. For example, there should be at least two exits in a divisional section, while I only designed one. Another problem is the distance between the furthest points of a divisional section to the exit. This is to make sure people in the building even at the furthest point are able to access the exit in time if a fire alarm is triggered. In my previous design, I did not take this factor into consideration …" (ZZ09)

"... When a building we are designing is very big, we normally divide the building into small blocks and design a kind of expansion joint between the blocks. The design of water supply and drainage system should fit in this expansion joint between blocks accordingly. When the pipes go between different blocks and through the expansion joints, a special pipe joint, flexible rubber expansion joint, will be installed to connect the pipes going from one block to another. Normally there are two different designs for the pipes going through different blocks. If there is a basement in the building, the pipes will normally go through the basement along the ceiling. You may probably see this kind of situation very often in a basement. If anything goes wrong with the joints, we can easily repair them with a ladder. However, if there is no basement in the building, the pipes will normally be designed going through different blocks under the ground. The project I did was such a situation, that is, no basement in the building. Then I planned the pipes under the ground, which means the pipes will be buried under the ground. Then a problem was raised. The flexible rubber expansion joint would rot if buried underneath. What should we do with it? This was the first project I did without a basement, so I did not realize this problem until the construction workers found it during their working and came back to us. Even our chief engineer did not find this problem when he reviewed my design…' (ZZ12)

C. Through discussion

Apart from active and passive awareness in advance and during a project, there is another way of becoming aware of a problem: through discussion. This kind of awareness is different from active and passive awareness in that people become aware of a problem via an interactive way, which can be both active and passive. They discuss a project together with other colleagues, sharing their ideas, perspectives, and experiences. It could be an informal discussion, like a chat between colleagues, or a formal discussion, like a project meeting led by the project team leader.

ZZ08 is a BSE in an architecture design company. When he was assigned as a team member of a project, he was also informed to attend a meeting to discuss the project together with other engineers:

> *"normally we will have a meeting to discuss a project, and see what problems we will have. We had a meeting to discuss this project as well … all kinds of engineers involved in this project attended this meeting, including construction design, structure design, and building services … this constructional scheme was originally designed by another company, which was not considered satisfactory by the client. Our aim was therefore to find out the problems and improve it … the aim of this meeting was to discuss what problems might exist in the project, such as the elevation of the building, building construction, the structural design, and the cooperation between each aspect. Normally in this industry, our leaders are also specialized people. They knew the project very well and would raise some problems in the meeting. Meanwhile, the engineers from different aspects would raise some problems from their perspectives. As such a construction project needs cooperation of different engineers, engineers would normally discuss what they want from, or what they could do for other engineers …after the discussion in the meeting we reached some consensus of some problems existing in the project. With regards to my specialized field, the fire prevention and evacuation became a significant problem in this project … After this meeting it became clearer for this project. The problems and the aim had been identified. My job next was to solve the problem in fire prevention and evacuation. As this building is a shopping mall which has 2-3 stories and covers more than 100,000 square meters, the fire prevention and evacuation is very important…"*

Apart from a project meeting, an informal discussion may also happen between different engineers to identify the problems. ZZ04 is an urban planning engineer. After he finished his design, ZZ04 went to see another engineer who was responsible for the road planning and design. They had a chat to discuss their project and to identify problems it might have.

> *"I finished my design by myself, and then I went to see my colleague who was in charge of the road design for this project. You know, we need to discuss together about this project to see if our design fit for each other. For example, if the location of the residential land, the public open space, and the vehicle access are coordinated together; where the public open space should be allocated, in order for a minimum influence on the city road planning … after we discussed together, we realized that the location of the public open space was not good considering the road planning, and the road access should also be replaced …"*

Different situations of being aware of a problem have been identified. We may be able to be aware of a problem by ourselves, namely actively. We may also be able to aware of a problem with the help of others, namely passively. Furthermore, there is the third kind of awareness of a problem: discussion. We may discuss a project with others to identify any problems in a project, which is actually an interactive way to find out these problems. However we are made aware of a problem, it may happen during the project or even before commencing a project. Thus, being aware of a problem may happen at any time during the knowledge seeking process.

6-5-3 Work for the solution

After a problem is found, a knowledge seeking process is triggered. The next step is to find out the solution to the problem to complete the project. 'Work for the solution' has been coded for this process, which includes three sub steps: Identify and analyze the problem, Generation of alternatives, and Decision making. This is a little different from the initial template. In the initial template, once a problem is found, the next steps are 'General orientation', and then 'Problem definition and formulation', 'Generation of alternatives', and 'Decision making'. 'General orientation', which refers to an individual's general orientation or set in approaching a problematic situation, has been removed from the template, since these activities are evidentially covered by the previous step: Be aware of a problem.

The other three steps in the initial template - 'Problem definition and formulation', 'Generation of alternatives', and 'Decision making' - have been grouped together into one larger stage, Work for the solution. This refers to an individual's effort to find out the possible ways to solve the problem. This has been done because there is no clear gap between the three steps at this stage. On some occasions, we spend a lot of time identifying and analyzing the problem, but we may find alternative solutions all of a sudden, and decide to employ a particular solution straightaway. On other occasions we may spend more time in generating alternatives after we have identified the problem, or we may work very hard to decide which alternatives can be carried out to solve the problem. Sometimes it is not that easy to find the boundary between each step. These steps may even occur in a cyclic way. These three major steps in the stage of 'Work for the solution' will now be explained.

6-5-3-1 Identify & analyze the problem

Once we are aware of a problem, the first thing we tend to do is to identify and analyze the problem, in order to work out possible solutions. The code 'Problem definition and formulation' in the initial template has been renamed 'Identify and analyse the problem', since this describes the step more precisely. In this step, we will make sense of the problem by understanding what exactly the problem is. The step defines all aspects of the situation in operational terms, and formulates or classifies elements of the situation appropriately, so that we can specify the major sub-problems, issues, or conflicts. The aim of this step is to make the problem clear based on information or materials as far as we can, preparing for the next step: Generation of alternatives.

A. Identify & analyze a problem based on existing situation

On some occasions, we might be able to make sense of a problem based on information provided, or say an existing situation. In other words, we might not need any further information or materials. This kind of situation has been coded as 'Identify & analyze the problem based on existing situation'. For example,

> *"when I was assigned to do this project, many project materials had been provided to me, such as the hypsography, the plan of the site engineering, the plan of the road, and the audit planning. What I did next was making clear the situation to understand the every aspects of the problem based on the information provided, such as the basic topography, the site levelling, and the level elevation". (ES01)*

ES03 identified and analyzed the problem based on the information provided as well:

> *"They provided me with the architecture drawing. What I should do is to design the water supply and drainage system for the building … so I analyzed the architectural drawing, the layout plan, to understand: where is the toilet, the kitchen, what size are the sanitary wares such as the sink, basin, tanks, bathtub, and etc. the distance between the sanitary wares. After I understand all this kind of information, and sort them out, I will then be able to solve the problem: design the water supply and drainage system…"*

ZZ01 encountered a problem after he installed the equipment into the building: where the temperature sensor should be installed? He identified and analyzed this problem based on the existing situation:

"I tried to work it out by myself firstly based on what I have known about this project ... Considering so many aspects of the existing system, for example, the pipe was installed from outside to inside of the building, or, some were installed from the top down to the building, anyway, where should it be properly installed based on this situation?"

ZMD 04 was asked to do a structural design for a richly ornamented gate. As this was his first job in a real project, this was a challenging job for him. He soon realized that there was a problem,

"… I started thinking about the problem, and analyzed it further. Based on the original design, what I did was mainly simplify the decorative design first … after analysis and simplification, the richly ornamented design was simplified into some frame structures. In this way, it would be easier for the structural design later …"

After being aware of a problem, ZMD05 tried to identify and analyze the problem for a solution:

"… this construction project was to build houses for a residential community. This kind of community requires being economic, and beautiful. The residents here prefer their houses facing to south. Based on this situation, the design of this community should be conducted around the residential houses. So the key point for the design of this community would be the road network, as the road network in a community decides the planning of the community. Once the road network in this community is planned, the whole problem will click into place …"

"After I realized this problem, I started analyzing the data and information provided in order to understand the real situation of this problem. This is a library, a heavy load construction. The allotment is a triangle. It has a street frontage and the other side faces the campus where there is a small square. This library should fit in the square … "(ZMD06)

B. Need further assistance in identifying and analyzing a problem

On many occasions a problem may not be identified and analyzed clearly based on provided information, or say existing situation. If we are not able to make sense of the problem, or if we find that the existing information is not enough for us to identify and analyze the problem, further assistance may be needed. We need more information to help us make sense of the problem and this leads to ‘information seeking’ activities. As stated by Wilson, problem solving is the underlying motivation for information searching. It is the problem that causes uncertainty, which makes information, namely further assistance, needed. Once we realize that we need more information to help ourselves to make sense of the problem, an information seeking process is triggered. In the interview data, there were lots of occasions when this kind of assistance was necessary, which had been coded as ‘Need further assistance’.

As the aim of this research is to explore the knowledge seeking process, that is, how we gain knowledge in the workplace, the data analysis in this stage turned to focus on the use of the information for the problem solving, rather than how we seek more information since this has been explored extensively in the information seeking behaviour research area. Three different ways of using further information have been identified: ‘For the current situation of the problem’, ‘For the requirements of solving the problem’, and ‘Heuristic information’. For example, ZZ12 remarked,

> *“normally when we got a problem, the first thing is trying to get more information to help our understanding of the problem, such as the general situation of the project, the surrounding condition. Then we need to consult the related Codes, which is the instructional law for us to design. Our job is actually to design according to the rules from the Codes and meet the clients’ requirements. As for the technical problem, we can also consult many other references to help us make sense of it.”*

This quotation has actually shown us the three different uses of information for problem solving: “*The general situation of the project, the surrounding condition”* implies the information for the current situation of a problem; “*the rules from the Codes and the requirements from client*s” imply the requirements of solving the problem, while ‘*many* *other references*' implies the heuristic information. In the following three sections, we are going to have a look at what happened to our interviewees to make further sense of these three different uses of information for the identification and analysis of the problem.

B1. For the current situation of a problem

Information for the current situation of the problem refers to the information that helps us understand the existing situation. For example, after she learnt the provided information, ES01 found she needed more information to help her identify and analyze the problem.

> *"I asked the client for Municipal Engineering Drawings as I needed to know the details of the in-situ data, such as the elevation of the water supply, and the drainage on the site ... I also need to learn about the municipal fire-fighting facility on the site as I am going to do the fireproof design. I need to know if there is any fire hydrant, what the size of it is, whether or not they meet the requirements of the community. All this information should be understood and analyzed before I start my design. Only after I understand the existing situation of the problem very well, can I commence designing and find out the best solution that is both economic and suitable." (ES01)*

Evidently, ES01 looked for more information here to help her better understand the existing situation.

When he analyzed the problem he encountered, ZZ04 realized that more information about the project was needed to help him learn about the existing situation.

> *"In order to do the regulatory detailed planning in this district, I need more detailed information. Then I looked for the topographical map and imaging map of this area. Then I needed to have a look at the developmental situation of this area ... We also need to know the previous situation of this area. For example, if there was a factory, we need to understand what kind factory it was and so on. All this information is very important for us to understand the existing situation of this area, which will help us do the plan later as our work will be based on this information ... after I collected the maps, I went to the district and conducted some field survey. This is to help us understand the existing situation further, to learn what is on site over there, what*

> *situation the buildings there are, how old the buildings there are, what can be removed while what cannot, what else around there should be taken into account ... after the survey, I got a better understanding with regards to the situation of the to-be-planned district. I input all the information I collected into my computer, which will help me to do the plan later.'*

ZZ10 decided to conduct a field survey to get more information about the site in order to understand the current situation of the problem better, as he had no idea about the task he had got:

> *"the first thing I did was to do a field survey. You know, landscape design is actually to plan the land, so I decided to have a look at the land first to learn the existing situation there. I wanted to know what elements I could use and what I would not. I also wanted to know the elevation value, soil, space, size, and surroundings over there ... as a landscape design, this basic information is the first thing we should know. We need to learn the elevation value, vegetation, buildings, surroundings, and so on, before we commence a design."*

B2. For the requirements of solving the problem

On many occasions, the engineers looked for more information to help them in another way to identify and analyze the problem, namely make sense of the requirements of solving a problem. They needed to understand the requirements of solving a problem before they worked out a solution of the problem. They needed to know the desired results of their solution to a problem before they found it out. The requirements appeared to mainly come from two aspects: the clients themselves and the Codes.

The Codes are very important for engineers, as they stipulate the rules or regulations for the design of most construction works. As explained by ZZ12:

"in our industry, the Codes are nationwide applicable law, which is established by the state. They should be complied with wherever they are applicable by all engineers in this industry; especially compulsory rules should be complied with very strictly. Otherwise your design will not be approved by the administrative department of the government ... therefore, we have to know the related codes very well before we commence our design."

The other main kind of requirements comes from the clients. As an old saying goes, 'The client is our God'. It is the client who decides what they want and what should be done for them. The clients are so important that the engineers have to do the project to meet the clients' requirements. ZMD01 explained this clearly:

"Do not be in too much of a hurry to commence your work. Communicate with the client first. This is a golden rule. When I started work in this industry, I made this kind mistake very often: I did the project based on my own understanding without considering the clients' requirements. After I completed my design and sent it to the client, I was told by the client that it was not what they wanted. So it is very important to understand what the client wants. You should understand the requirements of solving a problem before you start working out a solution. You should know your aim before you start."

When ZZ10 was trying to identify and analyze the problem in a project, which is to design a theme park and landscape centring on a forest of steles, he met the client and attempted to understand the client's requirements:

"First of all, I had to know what the client exactly wanted. The client would like their 'Forest of Steles' to be different from others. They wanted a modern design. As the project is located beside Yellow River and near the statues of the Emperors Yan and Huang, they would like the design to represent the local culture of Yellow River and the culture of Yan and Huang…"

When he was identifying and analyzing the problem, namely a central heating system in a building, ZZ01 decided to contact the engineers of the building to learn more information about their requirements for the system:

"I contacted that company and asked more details about the system, and the problem, their requirements, and so on. They told me that they had installed many types of equipment in the system. They hoped that the repair could be completed based on the existing equipments as far as possible. Anyway, I have searched all the references and related information before I replied to the company".

ZZ04 is an Urban Planning Engineer. When he got a project and was trying to solve the problem he met, he decided to look for more information to understand the requirements of the problem, including both the Codes and the client's requirement:

"We have many Codes in this area, so I have to consult the Codes first to learn the related rules and regulations. Sometimes I searched information from the internet to help my understanding of the rules especially when I could not catch the meaning of some rules from the Codes as they might be a little bit vague for me."

Furthermore, ZZ04 had a meeting with the client to understand the client's requirements:

"... I, together with other project team members, went to the client's office to meet them ... our aim was to understand the client's intention, namely what they intended to do in this district, commercial or residential use? What were their desired FAR (floor area ratio) and height for the buildings over there?"

As it was his first real project, when ES05 was identifying the problem he found he had no idea about the size of construction works, such as the diameter of the pillar, the thickness of the floor and the wall. He then decided to find out more information to help him to make sense of the project.

"I knew there were detailed rules in the Codes. So I found out the Codes for consultation. For example, what size and how tall a pillar should be; how thick a wall and the floor should be, especially for the cast-in-place concrete floor. I found all these requirements from the Codes and some other reference books ... I also asked my colleagues about this aspect, who told me a lot ...."

The Codes seemed very important for all of the engineers. They always mentioned the related Codes when they were talking about their work, which can be seen from many quotations:

> *"First of all, I found out all related Codes to learn the rules concerning the design of drainage system for a high-rise building. I should make sense of the related rules, and see what I should pay attention to when I design ... of course there are always some unclear points. Then I normally tried to ask the senior colleagues to help me. For example, I asked my supervisor about a code I did not understand, which is about the amount of fire hydrants in a building. It reads in the Codes: two streams of water should be able to access any place in the building at the same time in case of fire. After I consulted my supervisor, I knew this implies that at least two fire hydrants should be designed into each floor of the building." (ZMD08)*

> *"I had totally no experiences about this, so I had to ask my supervisor. My supervisor normally suggested to me the related codes. I then went to read and learn the Codes until I made sense of the related rules. My supervisor helped me a lot in understanding the rules from the Codes, which helped me making sense of the requirements of the project." (ZZ09)*

> *"The first thing I did was to find out the related Codes ... normally I also consult other engineers if I could not catch the meaning of some Codes, such as friends, colleagues, supervisors. I even went to the fire department of the government to consult them. As the administrative department, they can definitely help me understand the Codes ... anyway once you are able to catch the meaning of the related Codes, you will be able to make sense of the requirements of solving the problem." (ZZ08)*

B3. Heuristic information

Apart from above two use of information, the engineers sometimes looked for more information to help them make sense of the problem itself, which has been coded as 'Heuristic information'. If the existing situation of a problem is the place A, and the requirements of solving a problem as place B, the problem can then be seen as the gap between A and B. Heuristic information is to help us make sense of how we can reach place B from place A, or how we can achieve aim B based on situation A. We tend to find out more information to help us understand the relationship between A and B when we are identifying and analyzing a problem, in order to work out alternatives for the problem.

After he was aware of the problem, namely the central heating system, ZZ01 realized that he had totally no idea about the problem. So he went to the library to look for references to learn the fundamental principles of the central heating system.

> *"… The first thing I did was to look for references or data from library. I went to library and found some references. You know, the heating system is about water, steam, and how they are converted from each other and controlled. You have to learn this procedure, how the heat is exchanged. How the water becomes steam, and how the steam becomes water. You should learn this procedure. So I went to library first to learn these fundamental principles …"*

Besides this, ZZ01 went to the company intending to get more information. He chatted with the engineers there to help him make sense of the system as well:

> *"… I did not start yet. I went to the company to meet their engineers who are in charge of the system. Their job was to do the maintenance work. You know, as an engineer, they must know how the system works, and the processes. They might not know how to solve the problems, but they know more than me about the system. From the library, I mainly learn the theoretical aspects of this job, while from the engineers I can learn the practical aspects of the system. You know, sometimes, the theories and the practices are different. I have to learn something from the practical side … I have got all the references I can find from library before I start this project. It was no use to search in the library again, I thought. The problem was actually beyond my ability at that time. It was out of my scope. Then I decided to chat with the engineers in the company again. Anyway, they actually knew the system more than me … Again, I would not ask for the solution from them directly. I would not say I could not solve this problem. But I can discuss the problem with them. You know, at this stage, I have got this job. So I could discuss the problem with them more openly than before.… It was really helpful. At least, I have got a general idea about this job, the basic principle, theories of the system, and how it works …"*

Evidently, the information ZZ01 looked for helped him in understanding how the system worked when he was identifying and analyzing the problem. Heuristic information is mainly to help us make sense of the key question in a problem, or enlighten us answering the question of how, and the rule of thumb to solve a specific problem. Of course although there are different ways to look for the information, the use of the information is the same: to enlighten our understanding.

In order to understand the process of designing a water supply and drainage system for a building, ES03 asked her friend and a tutor, who helped her in different ways:

> *"I had no idea about it, could not understand how to start. Then I asked one of my friends, who was doing the design of water supply and drainage system in another company. He explained the whole process of the design, and listed some detailed and important points for me. I read it very carefully … I asked my tutor as well. My tutor then demonstrated to me how she worked on a design. I watched the whole process from the very beginning, namely modelling, to detail drawing, to system drawing, to the end. It really impressed me which helped me make sense of the whole process of doing a project…"*

On many occasions, the engineers look for this kind heuristic information to help them make sense of the problem:

> *"As for the problem, I looked for some previous data with regard to this problem. I never did this kind work before, but I believe that I can understand the problem if I have a look at a sample work someone else did … finally I found some on the intranet. Other engineers from our company had shared it.' (ZZ02)*
>
> *'I have made clear the desired result of solving this problem. However, I have no idea about how I can do it. What factors should be taken into account when I solve the problem? Namely how can such a problem be solved? … I went to ask my supervisor about it. My supervisor explained the key points of solving such a problem to me based on his experiences …. Actually, I did not really understand the problem at that moment … I came back and looked for some other reference books. I thought of this problem again and again. Finally, I began to make some sense of this problem' (ZZ05)*
>
> *'We analyzed the problem together. You know, after we had a look at this problem, each of us would have his own perspective about it, which were different…Then project team members had a meeting to analyze this problem together. Everyone spoke on his own perspective on the problem… Actually we were communicating different perspectives, which helped us to make sense of the problem… At the end, some key points of the problem were identified' (ZZ10)*
>
> *'In order to solve the structural problems from high-rising buildings, our company selected some engineers to be a team. I was one of them. We had some meetings to discuss and analyze the problems… Furthermore, in order to help us make sense of*

> *the problems, our company invited a senior chief engineer from another academy to hold a workshop for us, like a seminar. We could ask our questions about the problem to the chief engineer…our question were answered very well and the chief engineer also told us many of his experiences in solving this kind problem which helped us a lot in understanding the problem.' (ZMD02)*

> *'In order to get a better understanding of the problem, first of all, I looked for some reference drawings so that I can make sense of the steel structure, such as some practical engineering examples…I also contacted other senior engineers to discuss with them…I looked for some journal articles about the selection of different joints: what are the differences between different joints? What are the attributes of different joints? What are their advantages and disadvantages? And so on.' (ZMD03)*

6-5-3-2 Generation of alternatives

After we have identified and analyzed the problem, the next step is to work out the solutions. As there is normally more than one solution to a problem, this step is thus named 'Generation of alternatives'. This is the same as in the initial template, which is aiming to generate possible solutions appropriate to the problem identified previously. On some occasions, after the problem has been identified and analyzed, the engineers are able to find out solutions. On other occasions, they are not able to generate any solutions although the problem has been identified and analyzed. In such a situation, the engineers tended to need further assistance to generate a solution. These two kinds of situation have been coded as 'Generate alternatives' and 'Need further assistance'.

A. Generate alternatives

ES01 was reminded of a problem by the chief engineer in his company when she got the project, namely, the intercepting ditch issue in a project concerning with an outdoor drainage system. Although she was not aware of this issue by herself at the beginning, she generated a solution for this problem by herself immediately based on her existing knowledge:

> *"when I thought of this issue, I knew that an intercepting ditch is to intercept the water from the hill to the drainage system, and I knew how to deal with this problem… Although I had never designed any intercepting ditch before, I knew how to design a sewer. There are not much differences between them. They are actually the same thing but used in different places, so they are called something differently…therefore, I can solve it easily."*

After ZZ01 identified and analyzed the problem by consulting many reference books from the library and discussing with the engineers from the company, he got some ideas, that is, he had found a solution:

> *"I learnt much useful information from them, which I connected with what I learnt from the library. Basically, after I learnt from the library, and chatted with the engineers, I would say I had learnt a lot. At least, theoretically, I have got some ideas in mind."*

Later on, he got another problem after he installed the system, namely the temperature was too low. Again, he worked out the solution by himself after he identified and analyzed the problem:

> *"I worked it out by myself. I have learnt the theoretical aspects or fundamental principles of the system. Considering so many aspects of the system, for example, where should the pipes be properly installed, from the outside to the inside of the building, or, from the top down?"*

ZZ10's task was to design a theme park and landscape centring on a forest of steles. After he identified and analyzed the problem, he worked out some alternatives for the project by himself:

> *"after I analyzed the problem by seeking more information from the field survey and the client, I got some ideas…the ideas occurred to me suddenly like an inspiration… I*

actually got two ideas at the end… Once I got my first idea, I started drawing the draft plan, and thinking of the details… On the 4th or 5th day, when I nearly completed my draft plan, I suddenly got another idea, which I thought was better than the first plan. The first plan was a little bit too focused on the details, while the later idea was at a more macroscopic level…only about five minutes, I completed my second draft…"

ZZ12 is a BSE who was responsible for designing the fire-fighting supply for the building. After calculating the size of the fire pool, she realized that the size of the pool was too big for the basement, which did not meet the client's requirement. This was the problem for her. After she analyzed this problem by reviewing the Codes and the existing situation, she generated a solution:

"I analyzed the problem again and found out a solution… I decided to reduce the size of the fire pool but add another hose feeding water to the pool… In case of fire, the water from the pool will be used for fire fighting. However, the feed piping will feed water into the pool automatically at the same time. Namely the water is being supplied while you are using it… in this way, the size of the pool will be enough for the Codes, also meet the client's requirement."

B. Need further assistance

On many occasions, the engineers are not able to generate any alternatives by themselves, although they have identified and analyzed the problem. In these circumstances, they tend to seek further assistance to help them find out solutions. Two different assistances have been identified, namely 'Guidance or enlightenment', and 'Solution'. 'Solution' refers to the situation where the engineers are helped by being offered a solution directly for the problem, while the 'Guidance or enlightenment' refers to the situation where the engineers are not given any solutions to the problem but some guidance or enlightenments by which they work out solutions by themselves later on.

ZZ12 designed the water supply and drainage system for a very big building. As there were expansion joints between different blocks of the building, she designed a special pipe joint, flexible rubber expansion joint, accordingly. As there was no basement for this building, the pipes and the flexible joints connecting the different blocks were designed to be buried under the ground. However, the field workers realized that the flexible rubber expansion joint would become rotten if buried underneath, and came to ZZ12 for a solution to the problem. ZZ12 was not able to work out a solution for this problem herself, so she asked around for assistance, and finally got the solution directly from her teacher at the university:

> *"Finally I had to ring my teacher from the university who is 70 years old and is a very good engineer with rich experiences. I asked him if he knew this problem. He replied yes and gave me the solution directly…"*

ZZ02 did not realize the 'U turn' was a problem from his design until the chief engineer pointed it out for him. Furthermore,

> *"the chief engineer gave me the solution directly by telling me where and how I should add the U-turn point in the middle of the road… I corrected my design according to what he told me"*

ZZ09 asked her colleagues when she was not able to work out a solution:

> *"I could not find out a way for this problem. I asked one of my colleague, who knew how to do with it and told me the solution as well. He is a very experienced engineer in this aspect…' Later on, when she asked the chief engineer for another problem, 'the chief engineer knew how to do with this kind problem. He answered my question directly by giving me the solution…"*

ZMD02 did not find out anyone who can help him for solving the problem, but he found out the solution from another way:

> *"luckily, I found a book when I went to the capital of our province at that time. The book treats of this kind problem, as the author is a very famous specialist in this area who also involves in editing the Codes in our industry. The book explains this problem clearly and provides the solution directly for this kind problem… I thus solved the problem according to the book…"*

As shown above, the engineers might get a solution directly from others or via some other way. In many occasions, however, they did not get the direct solution but some guidance or enlightenments. The guidance might be some suggestions or explanations of the problem from others, or some sample solutions for similar problems. By the help of the guidance, the engineers were able to work out the alternatives.

As he could not work out any solutions, ES05 decided to ask for assistance from the chief engineer:

> *"as for this optimization problem, I had no idea at all. Then I went to ask our chief engineer for help… our chief engineer did not tell me the solution or answer of the question, but told me the principle of how to solve this problem. According to what he told me, I came back and thought of it again. Finally, I knew how to work out a solution for the problem…"*

When ZZ01 chatted with the engineers from the client company, he did not get the solution but some enlightenment:

> *"They said there were many reasons that might cause this kind of problem. And they suggested that it might be about the water flow, the pressure, and etc. Anyway, they gave me some ideas about it and reminded me of some possible reasons of the problem. But of course, they did not know the answer either. Just gave me some clue, some thoughts…"*

By the help of these enlightenments, ZZ01 was able to work out the solutions in the end.

As ZZ02 never solved this kind problem before, he could not work out any solutions. However,

"... I felt that I could do it if I have a look at the similar works that someone completed previously... I found out a drafting standard, and some works others have completed. Then I worked out my tasks according to these samples..."

ZZ09 asked her colleague for the solution of the problem, namely how to connect the glass curtain wall and the front wall of the building. Her colleague did not know the answer but helped her by suggesting that she looked for samples. By the help of sample drawings, ZZ09 was able to work out some solutions:

"I had no idea about how to do with the gap. So I asked my colleagues. My colleague did not know either but told me that I might be able to find some sample drawings about this problem from our database. He suggested to me to find out sample drawings ... then I looked for the sample drawings and finally I found out some from our database, which were similar to the problem I got. After I looked at the sample drawing, I got some idea of solving the problem and finally I worked out the solution".

Furthermore, ZZ09 introduced another way she receives help to work out solutions, namely, some professional internet forums:

"there are some internet forums specialized in construction industry, we normally discuss our problems on the forum to get solutions... we may not be able to get direct solutions for some problems there, but we can get suggestions from other engineers, which can be referred to when we are working for solutions."

6-5-3-3 Decision making

This step is the same as in the initial template, which refers to the situation where the problem solver decides which option can be applied to solve the problem. On many occasions, the engineer would make a choice of the solutions by themselves, immediately after they work out solutions. However, on other occasions, an engineer may have to defer to their clients, or their supervisors or the chief engineers in their company. Sometimes, he/she may have to discuss the possible solution with others, especially the ‘stakeholders’ of a project. These three situations have been coded as ‘decide by self’, ‘decide by others’, and ‘decide by discussion’.

A. Decide by self

Where the engineer has worked out only one solution for a problem, then they do not have to make a choice. The one solution will naturally be selected by them to be applied to the problem. However, if more than one solution has been worked out, the engineer will have to make a decision which alternatives to apply.

ZZ10 had worked out two solutions for his design of a theme park and landscape centring a forest of steles. He had to make a decision to select one of them to be the solution for his problem:

> *“I actually got two ideas at the end… The first solution was a little bit too focused on the details, while the second one was at a more macroscopic level…although I spent 4-5 days on the first solution, while I spent only several minutes on the second one, I prefer the second solution, which I think is more suitable for solving the problem…”*

B. Decide by others

On many occasions, when the engineers have worked out some solutions for a problem, they will have to consult others, especially their clients, to decide whether one solution is more acceptable than another.

Again, ZZ10 and his project team worked out three alternatives for the design of the theme park. In order to satisfy the client, they decided to meet the client and let the client make the decision:

> *"finally we have got three options… we then prepared a report based on these three options and went to meet our client. You know, our job should satisfy our client. So we report our solutions to them and let them make the decision which option is better…after our meeting, the client gave us their feedback. Basically they were satisfied with our work but asked us to synthesize the shining points of the three options and work out a new one."*

ZMD01 worked out a solution for his problem: designing an 'Art House' for a local university. After he worked out a solution, he sent his draft design to his client, the university:

> *"… after I completed my draft design, I sent it to the university to see if the solution is ok… after seeing the solution the university replied me with some suggestions for revision… I had to revise my design according to the client's feedback…"*

Apart from clients, the engineer's supervisors or chief engineers may become involved in making a decision amongst the alternatives since they normally have to approve the work. The supervisors and/or chief engineers would review the solutions, and give feedback or the 'right' solution. The engineer would then revise the solution according to the instructions. In such circumstances, the supervisors and/or the chief engineers are the 'real' decision makers of the solutions. This kind of situation was very common in the interview data:

> *"… I revised my design according to the supervisor's instruction until the project is completed…" (ES03)*
>
> *"… The chief engineer instructed me for the revision. Then I revised my solution according to his instructions…" (ZZ04)*

"…I kept revising my design according to supervisor's instruction until he said ok to the solution." (ZZ06)

"… Luckily, our chief engineer did not only point out the problem, but also told me how to revise the design, namely gave me the solution directly… I then came back and revised the design according to his instruction…" (ZZ08)

C. Decide by discussion

Besides the above two situations, there is another kind of situation for making a decision, in which the solution is decided via discussion. The people who are involved in the problem solving will meet to discuss and negotiate for a possible solution.

ZZ04 was planning a new urban area for further development:

"…there was an overhead high voltage line across the planned district, and in my draft drawing, urban open space was left under this line according to the Codes. However, the developer of this area did not like this solution, as the draft plan will make the land there difficult for them to develop. As a business man, the developer always wants to make the biggest use of the land of course. Therefore this draft plan is not good for the developer's further development in the area… in order to make a better plan for this district we had a meeting with the developer and discussed this issue. After our discussion, we agreed on a new solution …"

In a project team, the members of the team may include a number of engineers with different majors working together. As their designs for the same project would likely affect each other, they would normally discuss together when they are making a decision to select a possible solution for their problems.

As a construction design engineer, ZZ09 needed to discuss with the structural design engineer when he makes a choice:

"As a construction design engineer, when I am making a decision between the options of my design I will normally discuss my design with the structural design engineer in our project team, to see if my design will affect the construction structure…if my design is affecting the construction structure, the structural design engineer will have to revise his design… or if the structural design engineer says that his design cannot be revised, I will then have to change my options to revise my design. Namely, their opinion will affect my decision making for options…of course, sometimes the structural engineer asks me to revise as well due to the changes in the construction structure… "

ZMD09 is a structural design engineer:

"…my supervisor asked me to communicate with the ASE (architecture scheme engineer) to see if he can change the pillar at the front of the building. If so, it will be easier for us to design the construction structure…the ASE replied no… then I had to design the structure according to ASE's design of the architectural appearance. However, as the architectural appearance is too special, I had to discuss with the ASE again and again to see if he can revise his design a little bit... In other words, his design and my design are affecting each other, we need to keep communicating about our design in order to assist us in making the right decision between different solutions..."

6-5-4 Active experimentations

After a solution is decided, the next step is to apply the solution to solve the problem. This is the same as in the initial template, which refers to executing the actions that have been determined to solve the problem and checking their effectiveness. In this step, the options selected for the problem solving will be tested via experimentation. After further analysis however, two sub-steps have been identified, which are coded as 'carry out the plan', and 'verify the result'.

6-5-4-1. Carry out the plan

Once they work out a solution for a problem, the construction engineers will normally draw their design solutions via special software.

> *"…then I started making a drawing to express my idea. Actually it was a draft drawing at that moment… I had been thinking of my solution. Once I got some idea I started drawing…" (ZZ10)*
>
> *"… I put my ideas together and sort them out. Then I started drawing. The first step was modelling…I revised my design according to my supervisor's instructions…at the end, I completed the drawing" (ES03)*
>
> *"…Next, I started modelling via the software…finally I completed drawing all the basic design." (ES05)*
>
> *"…Based on the key points my supervisor told me, I made sense of the problem and got solutions. Then I started drawing…" (ZZ05)*

ZZ01, on the other hand, he did not carry out his plan via drawings like other engineers, since his problem was to repair the central heating system in an office block. Instead, he completed it in a real environment by installing or repairing equipment in the building:

> *"… then next is to implement my plan, to do what I thought in my mind… I worked out the solution by myself. Then I tried it during the implementation. On the second floor or the third floor? We did some experimentation…"*

6-5-4-2. Verify the result

The aim of all above steps is to maximize the chances that the selected solution will have a favourable outcome. So after the selected solution has been carried out, the overall outcome will be evaluated. This is to check if the solution is correct, or the result is meeting the requirements of solving the problem. It has to be mentioned here that this step is closely connected to the first step of the knowledge seeking process, namely 'be aware of a problem', as we tend to become aware of new problems once we have verified the results. In such circumstance, the failure of solving the problem or the awareness of a new problem will trigger another knowledge seeking process.

According to the interview data, the verification of the results for the engineers refers to the agreement or approval of their design. On the one hand, the verification may refer to whether or not their design is agreed by the clients. On the other hand, it may refer to whether or not their design can be professionally approved by the senior engineers or the related administrative department. Based on analysis of the interview data, there are three different ways to verify the results, which have been coded as 'by self', 'by others', and 'discussion'.

A. Verify the result by self

After the engineers have carried out their plan, they normally review the drawings against the desired outcomes as expected by their clients and the technical requirements of the related Codes. So, to some extent, they can verify the results by themselves.

ES01 talked about her first project of designing an outdoor drainage system. After she completed her design she reviewed her drawings repeatedly to check if anything was wrong:

> *"…actually I checked my work over and over after I completed my drawings. I found some problems with it, such as the gradient of the sewer ditch. According to the Codes, the gradient of the sewer ditch should be less than 15%. When I found this rule from the Codes, I checked my design at once…I did not know this rule before. I realized this rule when I reviewed my design against the Codes. I did not notice it before…"*

ES03 started carrying out her plan by modelling her design on the computer. However she realized very soon that there was something wrong with her solution and she had to redo it:

> *"…it took me a whole afternoon to model on the computer, but at the end I found it was wrong. I put some pipes in the wrong place. Then I had to redo it… again, when I nearly completed the modelling, I found that some pipes were still placed wrongly. You know the layouts of each floor of the building are different. I did not realize the differences. So when the pipes go from the top to the bottom, they might be placed through a bedroom or whatever, which is not allowed by the Codes…Once I found the problem I had to redo it…"*

ZZ01's problem was to repair the central heating system. After he worked out the solution he started carrying out his plan by installing and repairing the equipment. However it seemed that his solution did not work well:

> *"…after we installed everything, we began to debug the system. But we found this problem. The temperature is too low…for example, the temperature should be 25 degree but it was only 15 degree. Obviously there must be something wrong with my work..."*

B. Verify the result by others

On some occasions, the engineers could not see any problems with their solutions by themselves. Especially in the construction industry, all designs and drawings are supposed to be checked by the senior or chief engineers. So, it seems it is very normal that the results of the solutions are verified by others.

ZZ09 explained that, as a construction engineer, it is a rule that the construction drawings should be sent to the chief engineer in the company to check:

"All the drawings are supposed to be checked and stamped if there is no problem, by the chief engineer. After all aspects of the design are finished, the completed drawings will be sent to the relevant administrative department in the government for approval… my work was a six storey complex. The two bottom floors are for a shopping mall while the upper four floors are residential. After I completed the construction drawings, I sent them to the chief engineer for inspection…"

When ES01 finished her draft design, she went to see a senior engineer she knew to help her verify the result:

"…I went to ask an engineer to help me check my drawings…we are friends and he is a senior engineer who is specialized in outdoor drainage system. I wanted him to check if there is anything wrong with my design…"

ZZ12's design was mainly for fire prevention. So her design will be checked by the Public Fire Fight Section, which is in charge of building fire safety design. In such case, the results of the problem solving are actually verified by the Fire Department:

"…After I completed my design and printed out the drawings, we sent them to the Public Fire Fight Section for approval. However, it was not approved since it failed to comply with the Codes, according to the feedback from the Fire Department…"

ZM09 verified the result by sending his design drawings to his supervisor:

"the next morning I completed the drawings. Then I took them to my supervisor, who had a look at them and pointed out there was something wrong in the design. Furthermore, he told me that my design would definitely be failed by our chief engineer as well if I sent the drawings to him…at the end, he asked me to correct them…"

Furthermore, computing software also plays an important role in helping the engineers to verify the results. ES03 used special software, PDPM, to help her complete the drawings. This software is able to verify the modelling automatically:

> *"…the PDPM software is very clever. It is able to verify your modelling. So when I completed modelling my design, I checked it via this software…"*

The employment of software to verify the result also occurred to other engineers, such as ES05:

> *"…I had no idea about the results of the calculations…then I had to consult the software to help me…the software is intelligent, which will display red lines on the drawings if there is any problem in the design. So I used the software to help me check the result of my design. I kept correcting the related data and design until there was no red line showing on the drawings…"*

C. Verify the result by discussion

Sometimes the engineers, the clients, and the administrative departments may have different opinions about the results, that is, the design drawings. As a consequence, they then need to discuss the results together.

ZZ12 sent her drawings to the Fire Department for approval. However, it failed due to the department having different understanding of the related codes:

> *"…from my perspective I think my design has met the requirements from the Codes. But the Fire Department did not think so. We had to communicate with them… I went to Fire Department and discussed my design with them. We had a different understanding with regards to the Codes… after our discussion they finally agreed with me and approved my design".*

ZM01 designed a building for his client. However, as they had different opinion about his design, his client did not agree with him. ZM01 had to meet his client to discuss his design:

"…it was a long process. I communicated with the client many times. You know, it took me a whole week to just explain the size of the pillars on the ground floor. The client wanted the biggest pillar in the world as they would like the building very magnificent. But they are wrong. They are not professional people in construction so they had no conception about the size of a pillar. I explained to them that the size of the pillar I designed was definitely enough for this building… Considering the size of the building, the pillars were designed big enough. If they were too big, the building will be very ugly. Finally, they agreed with my design after we discussed it several times."

The discussion may also happen between the engineer and the chief engineer. When ZM02 sent his drawings to the chief engineer for verification, the chief engineer came and discussed his understanding of the relevant Codes with him:

"…the chief engineer came and asked me my understanding of some codes relevant to my design… actually there is no clear statement from the Codes with regards to the issue arising from my design. We looked at the 'Detailed Explanation of the Codes', but could not find any clear explanation of this question to consult… We discussed the issues in depth and come to an agreement in the end."

6-5-5 Knowledge learnt via reflection

In the initial template, there are two steps after active experimentations, namely 'concrete experiences' and 'reflective observations'. After further analysis, these two steps have been combined into one step, which has been coded as 'knowledge learnt via reflection' referring to the way engineers gain knowledge via reflection on their experiences from the problem solving process.

"… in our work, we will normally try different ways to solve a problem. You may find the final solution after you fail many times. Every time you fail, you could learn from it. Even if you were wrong, you can still get knowledge from it. As said by someone, we should analyze the failures more than successes; because the ways to success might be the same while the ways to failure are definitely different. Once we analyse our experiences, whether success or failure, we gain knowledge."(ZZ01)

Experiences do not only refer to the final result of the problem solving, whether the outcome is successful or not, they also refer to the whole process, from being aware of a problem, to working out the solutions, and to active experimentations.

When being asked how he sought knowledge from the process, ZM04 replied:

> *"…as for knowledge seeking, I think the most important thing is that you should do it first. Then you can learn from it… when you realize a problem, you cannot avoid it by just giving it up, or not thinking of it. Otherwise, you will not be able to do any challenging jobs, and you will not seek any knowledge. Only if you did it, faced with the challenge, and solved the problem you got, can you seek knowledge from the process…"*

After ES05 finished his project, he felt that he gained a lot from it:

> *"…after I completed the task, I felt I had learnt a lot from it… first of all, the knowledge of how to use the software. As I have solved every problem I got during the project using the software, I now feel very familiar with the applications… every problem I met during this project is actually a point of knowledge, which is also related to many other knowledge. Then by completing the work, I have learnt a lot from it."*

ZZ02 also talked about his feelings of seeking knowledge from his experiences:

> *"… I feel I know this kind problem very well now in my heart, as I completed this project on my own step by step. Before that, faced with this kind of problem what I would do was only bury my head in those drawings without any idea. But now I am very familiar with how to deal with this kind of project and am very clear about the whole process…I felt the workload was really heavy when I was working on the project, but after I completed it and reviewed the process, I found it was not that heavy. Because I have made sense of the problems in the project and have understood how to solve these kinds of problems, including the Codes, the software, what factors should be taken into account during the project, and the working steps of the process…"*

Apart from the professional knowledge of solving a technical problem during the project, the engineers also learnt other kinds of knowledge because of what they have experienced during the process. ZZ05 emphasized that professional knowledge is not the most important thing he has learnt from his experiences:

> *"…actually, apart from the professional knowledge, I think the process of how I sought knowledge in this project is more valuable for me. The professional knowledge itself is not that difficult actually… it is more valuable for me to make sense of how to deal with this kind project, the working steps, like what should I do first, second, and so on; where and how can I find out the useful information; the thinking mode of solving such a problem. The whole process of doing a project helped me make sense of it. The next time, when I am faced with a similar problem, I will know how to deal with it. What method I can employ to solve a problem..."*

As a building designer, ZZ10 also talked about his reflections when being asked what he gained from the process:

> *"…it is difficult to say what exact knowledge I learnt from it at this stage. It is more like an accumulation of experiences. As a designer, there is not a right or wrong way for working out a solution in most circumstances. It is better to say which solution is better or more acceptable. Inspirations are very important for us. Sometimes you can work out a good solution then a good idea occurs to you all at a sudden. But, of course, inspirations are also based on our previous experiences. As an old saying goes, well read, well informed. Different projects have different characteristics. Experiences are really important for us. It may be knowledge of how to represent different characteristic better and meet different requirements. If knowledge refers to these experiences, I have to say that the more you experience, the more you know with regards to how to represent different characteristics and to meet requirements. Then you will likely work out a better solution for your design."*

ZM01 talked about his feelings after he accumulated experiences from projects:

> *"… after implementing some projects, I realized that there is a procedure for how to do a project in this industry. Actually I was taught this procedure when I was in university. The first step of this basic procedure is supposed to be investigation, which refers to making clear the existing situation and the requirements of the clients. After that you can start your design. To be honest, I did not make sense of it until I completed several projects. I did not really investigate a project before, and never tried my best to learn the clients' requirements before I started a design, such as what did they really want? So I failed several times, as the clients were not satisfied with my design. When I reflected on my experiences I realized that the investigation phase was really important for us. We should always implement a project according to the procedure we have learnt from university, which I did not really make sense of*

> *actually. There are lots of this kind of situation during our work. After I found I learnt some knowledge from the work, I realized that I actually learnt it before when I was in university. But I did not really know until I worked on it and gained experiences from work."*

ZM02 reflected on his experiences by compare his work to other's similar work in order to improve his solutions in the future:

> *"… After I completed my project, I compared my design with others' design. I found that there were still some weak points in my design that needed further improvement. Comparison with others' work helps us find out the advantages and disadvantages of the solutions. If you do not compare you will not learn from it as you will not know what is good or bad. The more you do, the more experiences you will get, and the more you will learn from them…"*

6-5-6 A summary of the codes

The initial template has now been further developed, and apart from some changes to level one codes, many additional sub-level codes have been introduced from the data analysis into the developed template, which is displayed in Table 6-3 in the following.

In order to display the improvement of knowledge during the knowledge seeking process, two codes have been identified residing at the beginning and the end of the process, namely 'existing knowledge' and 'knowledge learned via reflection'. 'Existing knowledge' is to help us understand the knowledge situation of the engineers before they commence a knowledge seeking process, while 'knowledge learned via reflection' refers that the engineers learnt knowledge via their reflection on their experiences from the whole process of solving the problem, from being aware of a problem, to working out the solutions, and

Table 6-3: Developed template for the knowledge seeking process

1. **Existing knowledge**

2. **Be aware of a problem**
   - A. Active awareness
     - *a. Active awareness in advance*
     - *b. Active awareness during a project*
   - B. Passive awareness
     - *a. Passive awareness in advance*
     - *b. Passive awareness during a project*
   - C. Discussion

3. **Work for the solution**

   3.1 Identify & analyze the problem
   - A. Based on existing situation
   - B. Need further assistance
     - *a. Information for the problem*
     - *b. Requirements of the problem*
     - *c. Heuristic information*

   3.2 Generation of alternatives
   - A. Generate alternatives
   - B. Need further assistance
     - *a. Guidance or enlightenment*
     - *b. Solution*

   3.3 Decision making
   - A. Make decision by self
   - B. Make decision by others
   - C. Make decision by discussion

4. **Active experimentations**

   4.1 Carry out the plan

   4.2 Verify the result
   - A. Verify the result by self
   - B. Verify the result by others
   - C. Verify the result by discussion

5. **Knowledge learned via reflection**

to active experimentations. Through these two codes, we can notice the change of our knowledge structure in our mind as a result of the knowledge seeking process.

There is another step being added into the process, ‘be aware of a problem’. This step is not listed in the problem solving literature, which regards such awareness as a taken for granted precondition. However, being aware of a problem is very important in a knowledge seeking process as we will not learn if we are not be able to see any problem in a workplace. It is the awareness of a problem that makes us to start seeking knowledge for a resolution, although there are different ways to realize a problem: actively, passively, or interactively by discussion; in advance of a project, or during a project.

‘Identify and analyze the problem’, ‘Generation of alternatives’, and ‘Decision making’ have been categorized as sub-steps into ‘Work for the solution’ in the developed template, as there is no clear gap between the three steps in this stage. Very often, the engineers move swiftly through some of or all of the three steps. During this stage, the engineers are trying to find out the possible way to solve the problem. During this stage, further assistance may be needed to help the engineers especially in identifying and analyzing the problem, and in generating alternatives. They tend to seek more information to help them find out the solutions. The different uses of information have also been identified. For example, they seek information to help them in understanding the existing situation of a problem (coded as ‘information for the problem’), the desired results of a solution for the problem (coded as ‘requirements of the problem’), and how we can get desired solution based on existing situation of the problem (coded as ‘heuristic information’). When the engineers are generating alternatives, they may seek for ‘guidance/enlightenment’ or direct ‘solution’ for the problem.

After a solution has been worked out, it will be put into action for 'active experimentations', during which the solution will be carried out in the real circumstances (coded as 'carry out the plan'), and the result will be evaluated against the requirements of solving the problem identified before (coded as 'verify the result'). Obviously, this stage refers to executing the actions that have been determined to solve the problem and checking their effectiveness.

6-6 Chapter Summary

This chapter explained how the interview data was analyzed. Twenty six construction engineers located in three different cities have been successfully interviewed. Based on the primary data collected, the a priori codes previously identified from the literature were applied to the first transcripts, in order to develop an initial template for knowledge seeking. This initial template was then applied to the other transcripts in turn and finally, a developed template was constructed, during which various types of modification have been made, such as insertion, deletion, changing, etc.

In the developed template, five major steps have been displayed, ranging from 'existing knowledge', 'be aware of a problem', 'work for solution', 'active experimentation', and 'knowledge learned via reflection'. During 'work for the solution', three sub steps have been identified, namely 'identify & analyse the problem', 'generation of alternatives', and 'decision making'. During 'active experimentations', there are two sub steps: 'carry out the plan' and 'verify the result'. Furthermore, many additional sub-level codes have been introduced as well to demonstrate more detailed situations during each step. This developed template assist us understand how knowledge is sought by individuals in a workplace by illustrating the key elements of the knowledge seeking process in the workplace. The next chapter will further discuss the findings from the data analysis.

____CHAPTER SEVEN____

Presentation of Research Findings

7-1 Introduction

The previous chapters have displayed how the data is collected and analysed in detail. This chapter illustrates and discusses the main findings from the data analysis by connecting to the literature reviewed previously. First of all, the jigsaw links among the main themes of the knowledge seeking process will be displayed and discussed, namely knowledge sought from the experiences, the experiences enriched via the problem solving process, and the problems solved through the use of information. This is followed by a discussion of the evolution of knowledge seeking through a demonstration of its quantum jump from information seeking. After that, the importance of action taken in the knowledge seeking process will be discussed, and a summary of the integrated knowledge seeking process will be demonstrated. At the end, the position of knowledge seeking in the knowledge management cycle will be discussed, reflecting the adapted knowledge management cycle model developed in the previous chapter.

7-2 The jigsaw links among the themes of knowledge seeking

The themes from the literature with regards to knowledge seeking, namely experiential learning, problem solving, and information seeking, have been confirmed by the interview data collected from construction engineers. Moreover, the analysis focusing on the knowledge seeking process in the workplace has demonstrated an integrated jigsaw by combining or linking all these themes together. The following sections will discuss the links among these themes during the knowledge seeking process by illustrating how these themes are related to each other.

7-2-1 Knowledge sought from experiences

As knowledge seeking in this study has been defined as a learning process, we are actually placing the emphasis on individual learning behaviour in the workplace. If we are exploring what happens in the knowledge seeking process, we are actually attempting to understand how an individual gains knowledge by learning, or say how an individual learns in a workplace.

Many learning theories have been reviewed previously in the literature review chapter. Existing studies in workplace learning mainly focus on the factors effecting learning by developing different models of workplace learning. For example, Rylatt (1994) proposed some essential mindsets to the process of workplace learning transformation in order to develop a positive environment for workplace learning. Furthermore, according to Rylatt (1994), many influential factors must be considered during such a systematic and interactive process, such as the policy, programs, strategies, activities, business results, better competency, and highly satisfied people. Apart from the studies with regards to workplace learning, which mainly concerns the factors effecting learning like Rylatt (1994) above, research in informal and incidental learning mainly focuses on the informal or incidental characteristics of workplace learning; such as Marsick and Watkins (2001), Cseh, Marsick and Watkins (1999). Their research did not go further as for how such learning process happens, especially with regards to learning at the individual level in a workplace.

Based on previous work on learning, the experiential learning theory developed by Kolb (1984) to some extent answered this question. According to Kolb (1984, p38), 'learning is the process whereby knowledge is created through the transformation of experience'. From this perspective, individual experience plays a critical role in the knowledge seeking process, and knowledge is gained by grasping and transforming experiences. Kolb's experiential learning process constitutes two structural dimensions: the grasping experience dimension, and the transforming experiences dimension. In the grasping experience dimension, the abstract conceptualisation, which is grasped via comprehension (namely concepts and the associated mode of knowing), will be constructed from the concrete experiences, which is assimilated via apprehension (namely a primary mode of knowing, such as what we hear, see, and feel around us). The transforming experiences dimension, however, implies the transformation processes between the concrete apprehensions and the symbolic comprehensions of the world. As argued by Kolb (1984), we learn the meaning of our concrete immediate experiences by internally reflecting on our previous feelings or by acting on our apprehended experience and thus extending it.

Kolb's experiential learning has been confirmed by the data analysis in the previous chapter. When asked "could you recall anything that happened to you during your work, from which you think you have learnt a lot, or you think you got knowledge from it", all the engineers made replies concerning a concrete project or task they had experienced before. As analysed in the previous chapter, before they started a project or task, the engineers actually had some knowledge in mind, which is called 'abstract conceptualization' in the experiential learning cycle model, and has been coded as 'existing knowledge' in this research. By complete a project or task (which is called 'active experimentations' in Kolb's model), their experiences will be enriched (which is called 'concrete experiences' in Kolb's model). Consequently, the knowledge (which is called 'abstract conceptualization' in Kolb's model) will be gained by them through reflecting on their experiences of completing the project or task ('reflection observation' in Kolb's model). This has been coded as 'knowledge learned via reflection' in this research.

A flow chart explains this knowledge seeking process and experiential learning cycle more clearly. As shown in Figure 7-1 (adapted from Kolb, 1984), we apply our existing knowledge (abstract conceptualization) to the real world project or task (active experimentation). Then we gain experiences from it (concrete experiences). By reflecting on the concrete experiences (reflective observation), we gain knowledge (abstract conceptualization). Obviously, the knowledge we sought via reflective observation on the experiences, namely improved knowledge (indicated by shaded box), is now different from what we had before, which was called existing knowledge. There is an apparent improvement or change within the abstract conceptualization (indicated by broken-lined oval) in our mind after such a knowledge seeking process. The broken-lined arrow illustrates the improvement of knowledge revealing the knowledge seeking process.

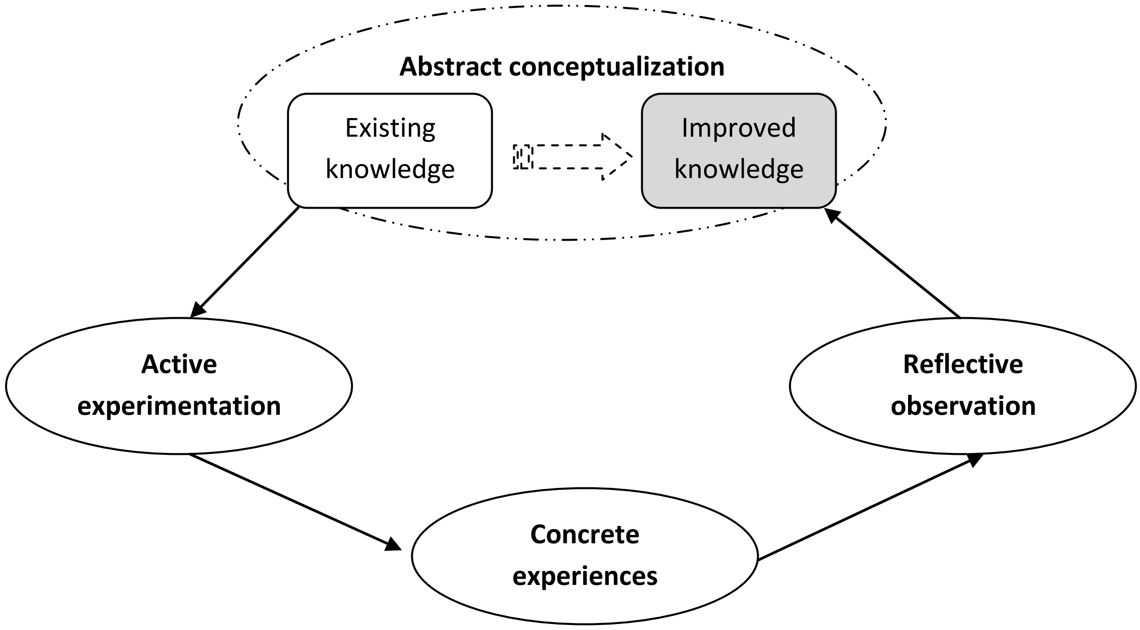


Figure 7-1: Knowledge seeking via reflecting on experiences (adapted from Kolb, 1984)

It is clear from experiential learning theory and also confirmed by the experimental data from this study that we can seek knowledge via increasing our experiences and reflecting on them. As stated by Hassell (2007), knowledge is always embodied and is always the experience of some individuals in a society. However, as for how we increase our experiences, experiential learning theory did not give us more detailed answers apart from a step in the cyclical model called 'active experimentation'. What happens in 'active experimentation' to enrich our experiences then? The analysis of data in this study has provided us with more detail. This is discussed in the following section.

7-2-2 Experiences enriched via problem solving

During the pilot interviews, the interviewees were asked to recall a real task or project they have done before, and to list what happened to them step by step during the project. Then the respondents were asked more detailed questions into each individual step to explore the process. However, the result of pilot interviews did not show a clear process of knowledge seeking, as in many cases the engineers complete their job in a routine manner. In other words, they knew how to complete the tasks or project. What they did in the project was just to repeat what they did before. The data from the pilot interviews were not able to demonstrate a process of knowledge seeking, but information usage during a routine job. This kind of project or task they completed does not necessarily enrich their experiences.

In order to focus on the knowledge seeking process during the interview, the question was modified to ask the interviewee "could you recall anything that happened to you during your work, from which you think you have learnt a lot, or you think you got knowledge?". Without expectation, this question anchored the interviewees into a real situation, in which they did learn or seek knowledge. Furthermore, it is shown from the data collected that all the engineers place more emphasis onto the problem they encountered during the completion of the project or tasks. They are aware of any problem and then move on to solve the problem. After they find out the solution to the problem and eventually complete the project, they find they obtain the knowledge from the process.

C'zurilla and Goldfried (1971) define a 'problem' as a specific situation or set of related situations to which a person must respond in order to function effectively in his environment, while a situation is considered problematic if no effective response or alternative is immediately available to the individual confronted with the situation. Based on this understanding, problem solving is thus defined by them as a behavioural process, which makes available a variety of potentially effective response alternatives for dealing with the problematic situation.

The relationship between the problem and learning has actually been discussed by some researchers. According to Anderson (1993), the original learning experiments undertaken in the 19th century involved cats learning to solve the problem of getting out of a puzzle box, which concluded that the cat managed to get out of the puzzle box by a trial and error process. The famous American educational philosopher John Dewey's (1859-1952) research (in Fainburg, 2009) also relied on problematic situations and reflective thinking. As stated by Fainburg (2009), Dewey's thoughts are focusing on the relationship between thinking and action where problem solving is a learning process. Revans' (1982, p626) action learning theory is defined as 'a mean of development through responsible involvement in some real, complex and stressful problem to achieve intended change to improve their observable behaviour henceforth in the problem field'. According to Revans (1982), learning is programmed knowledge plus questioning insight, which argues that individuals in the workplace learn from experience through reflection and action, usually to solve problems they meet at work. In other words, learning occurs in the process of finding solutions to problems in the workplace.

As has been analysed in previous chapter, being faced with a project or task is not necessarily a trigger for a knowledge seeking process, as we may be able to fulfil the task easily in our own way. In such circumstances, a knowledge seeking process will not be triggered as we are able to complete the project based on our existing knowledge. Only when we realize there is a problem to complete a project, will we attempt to solve the problem, and consequently, a problem solving process will be commenced. It is such a problem solving process that enriches our experiences, and we are thus able to seek knowledge via reflecting on the experiences as we have discussed previously. Based on this, the active experimentations in figure 7-1 were found from the data analysis to be a problem solving process (see shaded box in Figure 7-2).

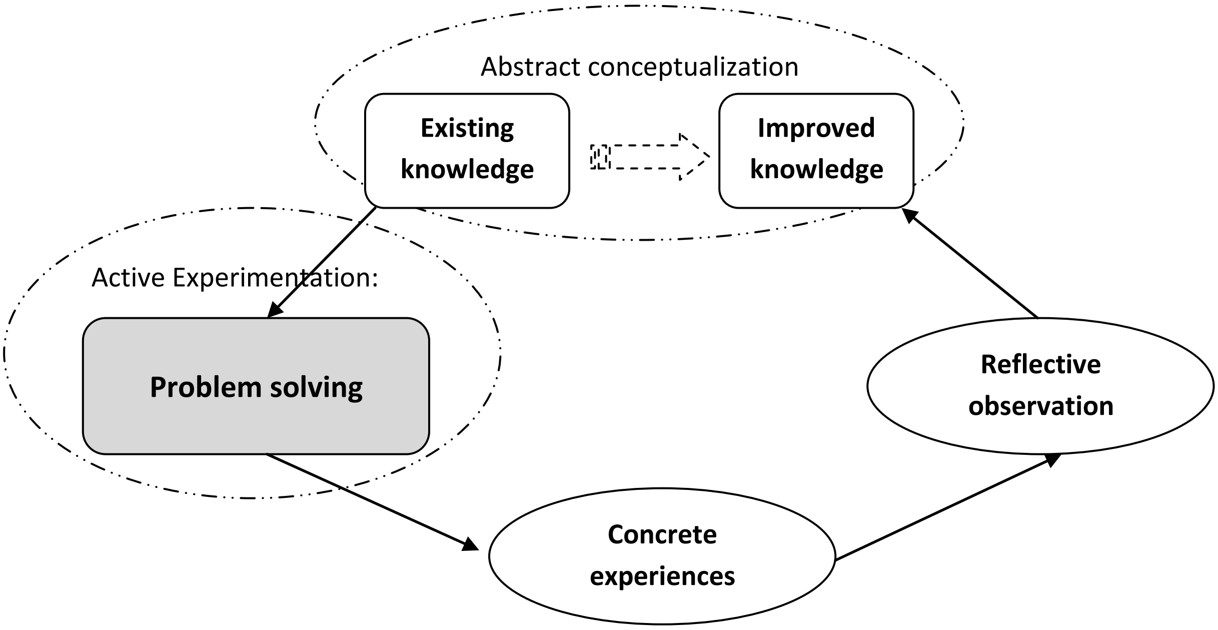


Figure 7-2: Experiences gained from problem solving

In the data analysis, the problem solving process has been explored further and deconstructed into more steps. The first and most important step was found to 'be aware of a problem', which is the trigger for all subsequent steps. The research with regards to problem solving has been traced back to the early 1900s. Many problem solving models have been developed since then, which have been reviewed previously. Among these different models describing the steps that happen in the problem solving process, however, all seem to assume that a problem has been found. In other words, this research regards being in a problematic situation as a presupposition by assuming that we have been aware of a problem. As a result, all the problem solving process models start with how to deal with such problematic situations. However, this is not the fact actually from the data, as we may sometimes not be aware of any problem at all. Especially when we are exploring the knowledge seeking process, being aware of a problem is actually a trigger or start point for us to learn.

As a main theme of knowledge seeking, the problem solving process has been analyzed further during data analysis in this research. Three types of awareness have been identified where the engineers were able to realize a problem by themselves in advance of a project, or during a project, which has been coded as ‘active awareness’. Some other times, however, they were not able to find any problem until others pointed it out for them, which has been coded as ‘passive awareness’. Moreover, there is another way for them to realize a problem: discussion, which refers to a situation where they find out a problem when they discuss a project with colleagues.

As being aware of a problem is so critical for the seeking process, this step has been listed as an individual stage during the knowledge seeking process (see figure 7-3). This is different from traditional problem solving process models, which actually start the process after a problem has been realized. Actually, only when you are able to be aware of some problem, will you attempt to solve the problem and thus enrich your experiences. From this sense, being aware of a problem becomes a vital link between problem solving and experiential learning in the knowledge seeking process.

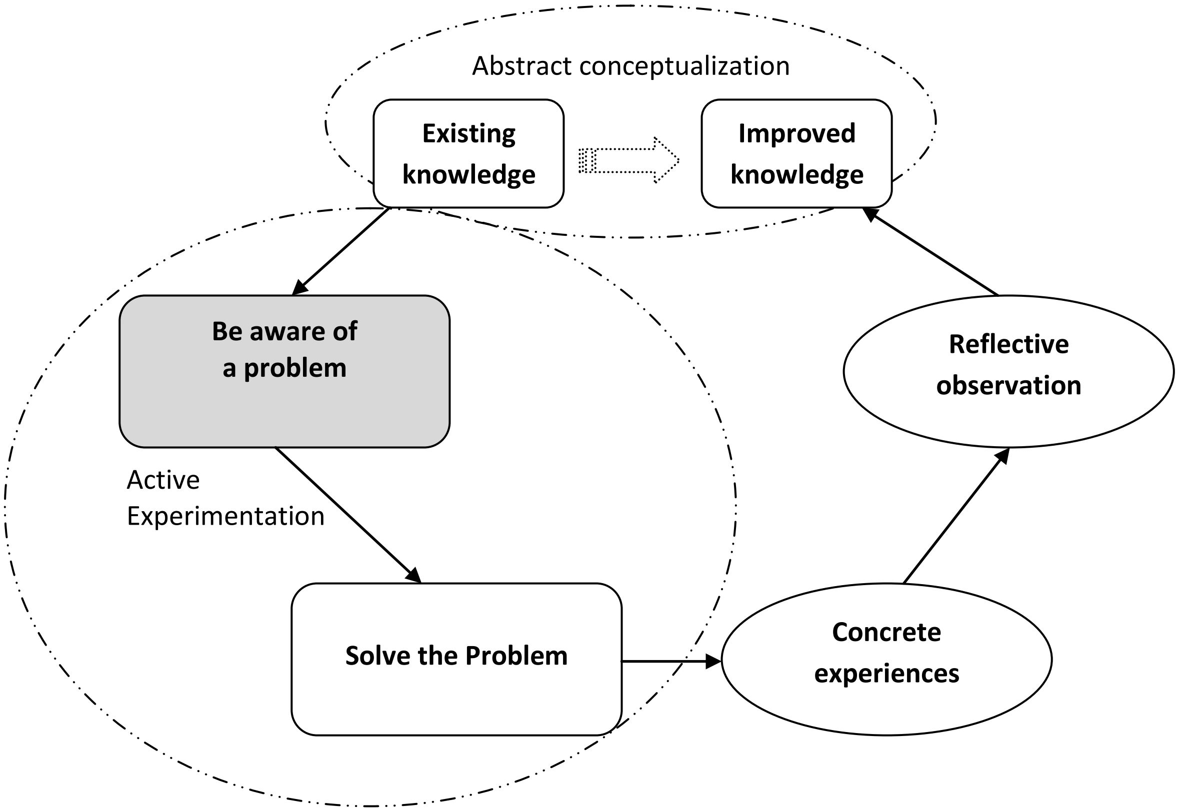


Figure 7-3: Be aware of a problem in knowledge seeking

7-2-3 Information is supportive for problem solving

The relationship between information and problem solving has also been discussed by many researchers. In much information research, identifying a problem is actually a trigger for information seeking behaviour. As argued by Wilson (1999), when an 'information need' was perceived or identified by an information user, he tended to start his information seeking behaviour to satisfy this need, while information need is not a primary need but actually a secondary need arising from another more basic kind of need, which is caused by a gap or uncertainty. Then, what causes this gap or uncertainty? A natural answer is 'a problem'. As stated in Fainburg (2009), only problem solving initiates uncertainty and perplexity.

This link between problem solving and information seeking has been confirmed by this research. When the engineers are not able to make sense of the problem they encountered, an information need is then perceived and they tend to seek further assistance, namely more information, to help them in identifying and analyzing the problem. Moreover, when they are not able to work out resolution alternatives for the problem, they also tend to seek further information to assist them.

As this study is focusing on knowledge seeking behaviour, the information seeking behaviour, namely how they seek information, is not the focus of this research. However, it is necessary to explore further with regards to how information helps during this problem solving process. It is necessary to explore what kind of information the engineers sought to help them in the different steps. It has been identified from the research data that there are two steps connected to information seeking, namely 'identify & analyze the problem' and 'generation of alternatives' (as shown in figure 7-4). When the engineers realize a problem, they then attempt to solve the problem. The first thing they tend to do is to identify and analyze the problem in order to understand what exactly the problem is. Based on the existing information, they may not be able to make sense of the problem. They then start to seek further information to help them in identifying and analyzing the problem. After the problem is identified and analyzed, namely after they have made sense of the problem, they will attempt to work out some possible resolutions to the problem. Sometimes, however, they are still not able to work out any alternatives.

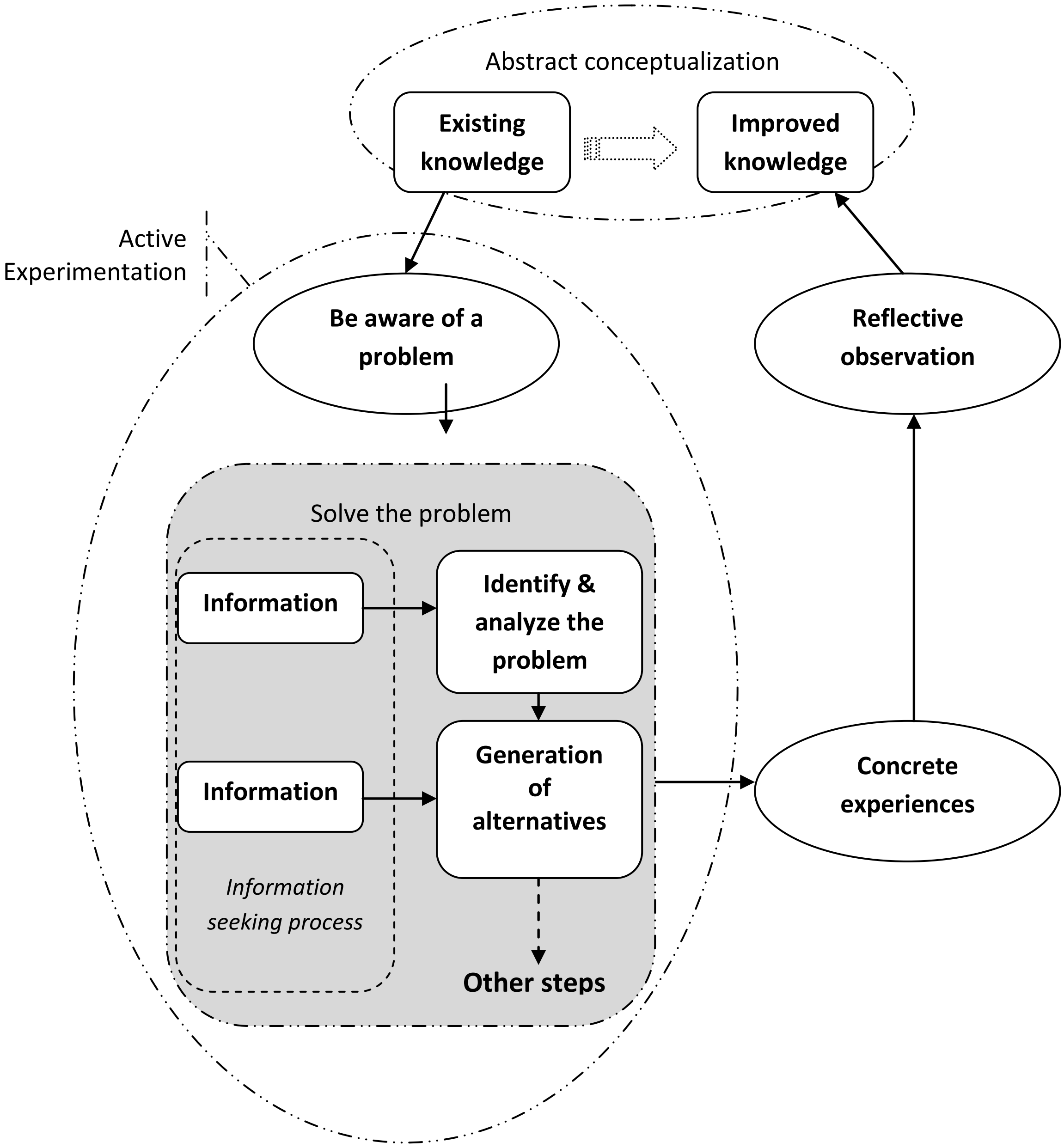


Figure 7-4: Problem solving by the help of information in knowledge seeking

In such circumstances, they will have to seek further assistance, namely perform information seeking, again. As stated by Kuhlthau (1991), the information search process is a constructive activity to find meaning from information in order to extend users' knowledge on a particular problem or topic.

7-3 From information seeking to knowledge seeking

Most information seeking research tries to explore the information seeking process by displaying the consequent steps the information users go through, and different influential factors affecting such a process. Since the 1990s, there has been some research using the notion of ‘knowledge seeking’, ‘knowledge sourcing’, and ‘knowledge acquisition’. However, it is no different to previous information seeking research, as they all regard knowledge as a noun, or an object, which can be found directly from somewhere. Among these research studies, many process models have been developed to demonstrate how we seek information step by step. However, it is unknown from these studies how the information helps us to make sense. As stated by Johannessen et al. (2002), if a person, with the help of information, is able to develop conceptual systems for the part of the environment acting as guidance, this person has developed knowledge. So how do we develop our knowledge by the help of information?

Compared to previous research in information seeking, which focuses on information users’ behaviour, namely how and where they seek information, this study places emphasis on the use of the information or how the information helps the users to make sense during the problem solving process, and eventually develop knowledge. Based on this sense, the data analysis has turned to focus on the different uses of the information rather than how and where the engineers seek information. Five different ways of using information in different stages have been identified: ‘For the current situation of the problem’, ‘For the requirements of solving the problem’, ‘Heuristic information’, ‘Guidance/Enlightenment’, and ‘Solution’.

For example, as stated previously, it has been identified that there are two steps during problem solving connected to information seeking: ‘identify & analyze the problem’ and ‘generation of alternatives’. When we are identifying and analyzing the problem, we may need further information to help us make sense of the problem. Information of the current situation for the problem refers to the information that helps us understand the existing situation of the problem. Information for the requirements of solving the problem implies the desired results of their solution to a problem mainly from the client and the Codes. The ‘Heuristic information’ is mainly to help us make sense of our puzzles and questions in a problem, and enlighten us in answering the question of how. Actually in much literature, this kind of information is so-called ‘knowledge’ especially for those who use the words information and knowledge in overlapping and confused ways. The information for the current situation is to help us learn where we are now, and the information for the requirements of solving a problem is to help us understand where we are going, while the heuristic information is to help us understand how we can go from here to the destination. It is the different use of information that helps us in different ways to identify and analyze the problems we encounter.

After we make sense of the problem we are faced with, we may still not be able to work out any possible resolution for it. In such circumstances, we may have to seek more information to help us generate alternatives. There are two different kinds of information being identified to help us in this step, namely ‘Guidance/Enlightenment’ and ‘Solution’. ‘Solution’ refers to the situation where engineers are helped by being offered a solution directly for the problem, namely the right answer, while the ‘Guidance or enlightenment’ refers to the situation where engineers are not given any solutions for the problem but some guidance or enlightenment by which they work out solutions by themselves later on.

The above findings from this research have shown us the different uses of information for the information users. Based on this, information seeking becomes a part of knowledge seeking. When we encounter any problem during our work, we start a problem solving process, during which information becomes a kind of help for us, like product fodder or raw materials (Dervin, 1998), to make sense of the problem and to work out solutions.

7-4 Action taken in knowledge seeking process

The early behaviourist learning theory, which is mainly based on experiments with animals, and then generalized onto humans, emphasizes the principle of 'stimulus-response', and assumes that human beings are essentially passive, responding to the stimulus. The later behaviourist learning theory, like Bandura (1977), assumes that human beings learn from one another by observing, imitating, and modelling others' behaviours, namely a person's behaviour and the world around influence each other. Compared to behaviourism, the cognitivist paradigm places an emphasis on human's cognition, the so-called 'black box' of the mind. A person is seen as an information processor. The mental processes include thinking, memory, knowing, and problem solving. The information comes into one's mind, then is processed by the mind, and finally leads to some outcomes.

Obviously, cognitive learning theories tend to emphasize cognition over effect, while behavioural learning theories deny any role for subjective experience in the learning process. The experiential learning theory, however, is different from the above two learning paradigms. According to Kolb (1984, p38), learning is a "process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience". This is emphasizing the central role that experiences play in the learning process. Similar to experiential learning, action learning is defined by some researchers as learning from and critical reflection upon concrete experience (Zuber-Skerritt, 2002). However, action learning attaches more importance to ‘question’, namely people question their own direct experiences, which implies that individuals in a workplace learn from experiences through reflection and action, usually to solve problems they meet at work.

The findings from this study respond to the research in workplace learning by developing further detailed actions during the knowledge seeking process. When the engineers worked out possible solutions for the problem they met, they decided to take action to test if the solution worked by carrying it out. This stage has been coded as ‘active experimentation’, which is the same as in experiential learning theory. Two sub steps have also been identified during this stage, namely ‘carry out the plan’, and ‘verify the result’. In the knowledge seeking process, via these steps people are actually moving from cognitive insight in the mind to concrete actions in a real world. It is such actions taken in the knowledge seeking process that make us connect our cognition in the mind to the concrete real world, and thus make us learn. As stated by Pedler (1997, p26), ‘there is no learning without action and no sober and deliberate action without learning’.

From a cognitive perspective, the knowledge in the mind refers to individual cognitive structures, which is an internal product. From a sociocultural perspective, however, the representations of knowledge in the mind are developed by the outside social circumstances. As the bridge of these two perspectives, the situated learning theory emphasizes the mutuality between the individual cognitive structures and the social circumstance, stating that the cognitive structures are constructed and developed in a certain social circumstance. From this sense, it is the action taken in knowledge seeking that connects the cognitive structure and the real social circumstances. As defined by Lave and Wenger (1991, p49), 'Learning, as increasing participation in communities of practice, concerns the whole person acting in the world'. According to them, learners understand the world via their participation within the structured frameworks, which is active participation in the practices of social communities.

The importance of action in knowledge seeking found from this research also echoes much other research in learning. For example, Inglis (1994) adds 'Implementation' into Revans' equation by arguing that action must be taken not just suggested from others; Marsick and O'Neil (1999) argue that action is the start point for learning, and people reflect on their experience followed by action again. According to Fox (1997), knowledge is not independent but embedded in the circumstances of its application. It therefore has to be emphasized here that it is the action in knowledge seeking that enables the abstraction of principles applied from specific instances to novel situations.

7-5 A summary of the knowledge seeking process model

This research aims to explore the knowledge seeking process in the workplace. One of the objectives (Objective 4 in Chapter One) is to develop a theoretical model conceptualising knowledge seeking that integrates key elements of the process. According to the data analysis, a process model has been produced showing key elements involved in the process and the relationship of each step in the knowledge seeking process (Figure 7-5).

As shown in Figure 7-5, before we start a knowledge seeking process, we have normally obtained some knowledge, which can be seen as existing knowledge in the mind. Based on our existing knowledge, we may be aware of problems when we are faced with a project or a task. According to the analysis, we may aware of a problem by ourselves actively in advance of a project or during a project. We may also be aware of a problem passively in advance of a project or during a project, namely someone else may point out a problem we may have for us. Furthermore, we may also be aware of a problem by discussion with others, which could be seen as an interactive way to find out a problem.

Once we are aware of a problem during our work, a knowledge seeking process will then be triggered. The next step we do will be trying to solve the problem and fulfil our tasks. First of all, we will need to work out the solutions for the problem. In order to work out the solution, there are three steps identified, namely identify and analyze the problem, generation of alternatives, and decision making.

When we are able to make sense of the problem based on the existing situation, we will naturally go to the next step. However, if we are not able to identify and analyze the problem based on an existing situation, we will have to demand further assistance, which is actually to find out useful information to help us identify and analyze the problem, and eventually make sense of the problem. Three different uses of information have been identified from the data analysis: information for the problem, requirements of the problem, and heuristic information. The information for the problem is to help us understand the existing situation of the problem, while the requirements of the problem are to help us understand the desired results of solving the problem. The heuristic information however is to help us make sense of the previous two kinds of information and the relationships between them.

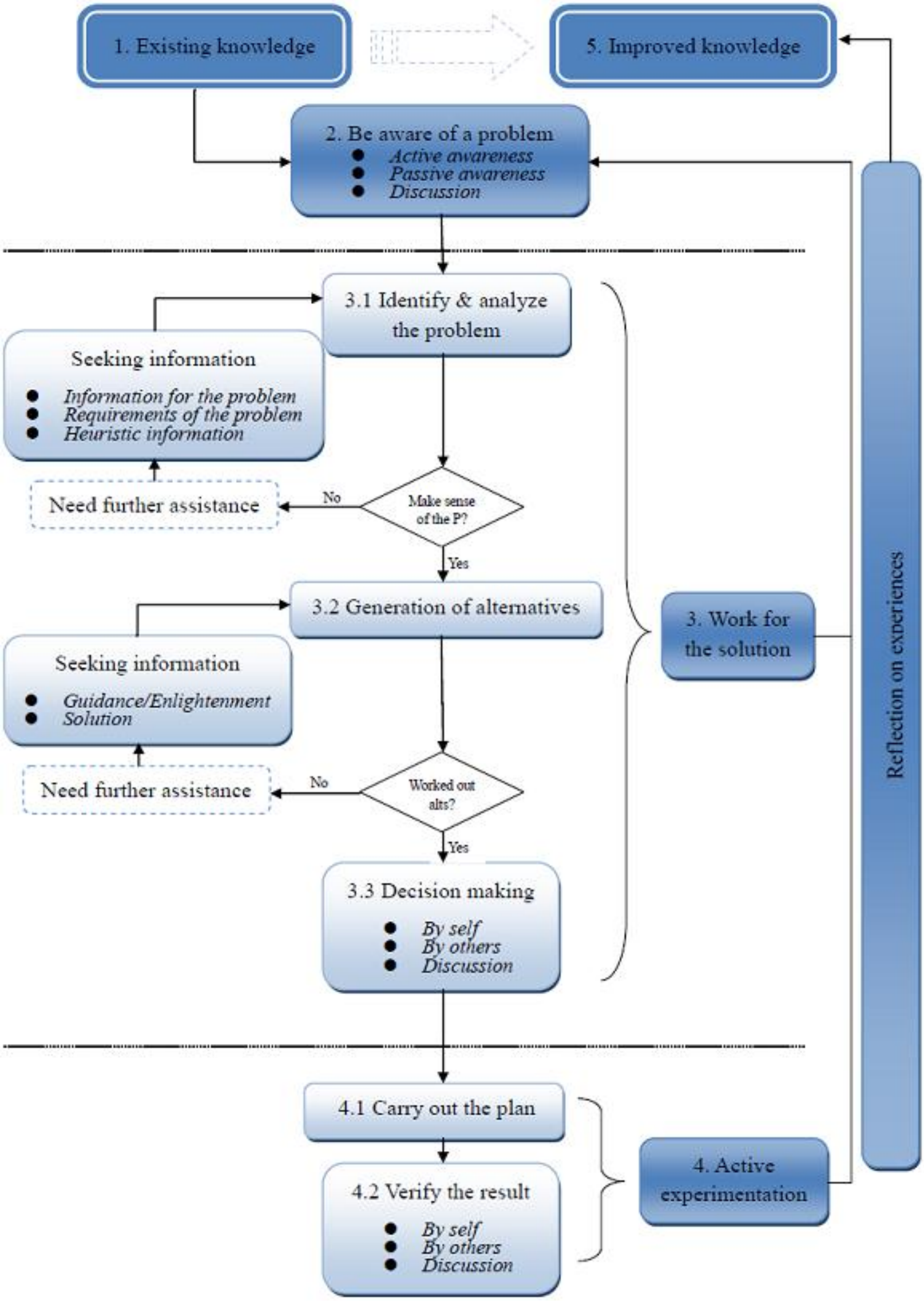


Figure 7-5: Knowledge seeking process

If we are able to identify and analyze the problem and make sense of it, we will try to work out solutions for the problem. If we successfully work out any alternatives, we will move to the next step. However, if not, we will have to demand assistance again to help us work out solutions, which, again, is actually to find out useful information to help us work out any solutions. Two different uses of information at this stage have been identified, namely solutions, and guidance/enlightenment. Sometimes, we can get direct solutions from others, however, in many occasions we may only find out some guidance or enlightenments from others, which helps us work out solutions for the problem.

Sometimes, we are able to work out more than one solution for a problem. In such occasions, we will have to make a decision as to which one we will select as the favourite solution. The analysis has found three different ways to make a decision at this stage: by self, by others, and by discussion. Sometimes we make a decision by ourselves while sometimes we will have to ask our supervisors or the clients to decide the favourite solutions for the problem. Furthermore, we sometimes make a decision by discuss a problem and make the decision together with others.

After we work out a solution for the problem, we will move to the next step, namely active experimentations. Two sub steps have been identified: carry out the plan, and verify the result. To conduct active experimentation, we will have to carry out the plan at the first place. This is to take actions to solve the problem according to the analysis and the solutions we have worked out.

Once we carried out the plan, we will normally evaluate the result of the problem solving to see if we have met the requirements of the desired results. If not, we will then have to redo it until the problem is solved successfully. Again, there are three ways of verification:

We sometimes evaluate the result by ourselves, while sometimes we will have to ask our supervisor or clients to verify the result; thirdly, we may verify the result by discussing it with others, such as friends, or colleagues.

After we have gone through all these process, whatever the result succeeded or failed, we will gain various experiences from the process. Based on these experiences, we will, consciously or not, be able to reflect on them and eventually improve our existing knowledge. Then we will say a knowledge seeking process is completed.

However, it has to be emphasized here that the steps in the knowledge seeking process as shown in the picture are not that clear and separate in our real life environment on many occasions, namely we may stay on some step for a long time, or we may also move over several steps swiftly at a time on some occasions. Furthermore, this process tends to be an iterative cyclic process as we may turn back to a previous step over and over again. For example we may be aware of a new problem at any step and will have to go back to the beginning and restart a new process.

7-6 Knowledge seeking in knowledge management cycle

As has been discussed in a previous chapter, King, Chang & Haney (2008) synthesized knowledge management cycle models in the literature and developed their own model to present a generic view of most previous cycle models (see Figure 2-3). According to King, Chang & Haney (2008), after knowledge has been created or acquired, it will be refined and stored, then be transferred or shared to those who need it. Once knowledge is utilized, organizational performance will be improved.

The researcher of this study, however, modified this model to a new version (see figure 3-3) based on the nature of knowledge, and the discussion of the differences between information and knowledge in Chapter Five. In the adapted version of the KM cycle models, all the activities or phases listed have retained their previous names as in the original model in order to allow a comparison. The researcher strongly argued that Part A in Figure 3-3 is actually the crucial part in real 'knowledge management' and named it 'knowledge seeking' in contrast with the popular concept of 'knowledge sharing'. It is the knowledge seeking rather than knowledge sharing that makes knowledge transfer or knowledge creation possible. He stated that this new model at that stage was still illustrative and not necessarily definitional, and the activities or how people gain knowledge in part A still needed further examination.

The findings from this research helped us achieve research objective N0. 4, namely to develop a theoretical model conceptualising knowledge seeking that integrates key elements of the process. A theoretical model has been developed in previous section. Now, we can go a little further to discuss how this theoretical model settles in knowledge management cycle and provide a response and improvement to the adapted KM cycle model.

As shown in Figure 7-6, Part A has been developed further by this study, displaying how individuals improve their knowledge via such a knowledge seeking process and by the help of information provided from Part B. During the knowledge seeking process, as discussed previously, when we are passively aware of a problem, we are actually receiving related information from others. By the help of the information, we may be able to be aware of a problem existing in our work. When we are identifying & analysing the problem, and generating alternatives, we also need help to obtain information from others. It is the information like fodder and raw material that helps us make sense of the problem and eventually develops our new knowledge in our mind. Our knowledge gets improved via this knowledge seeking process, while consequently the organizational performance is enhanced.

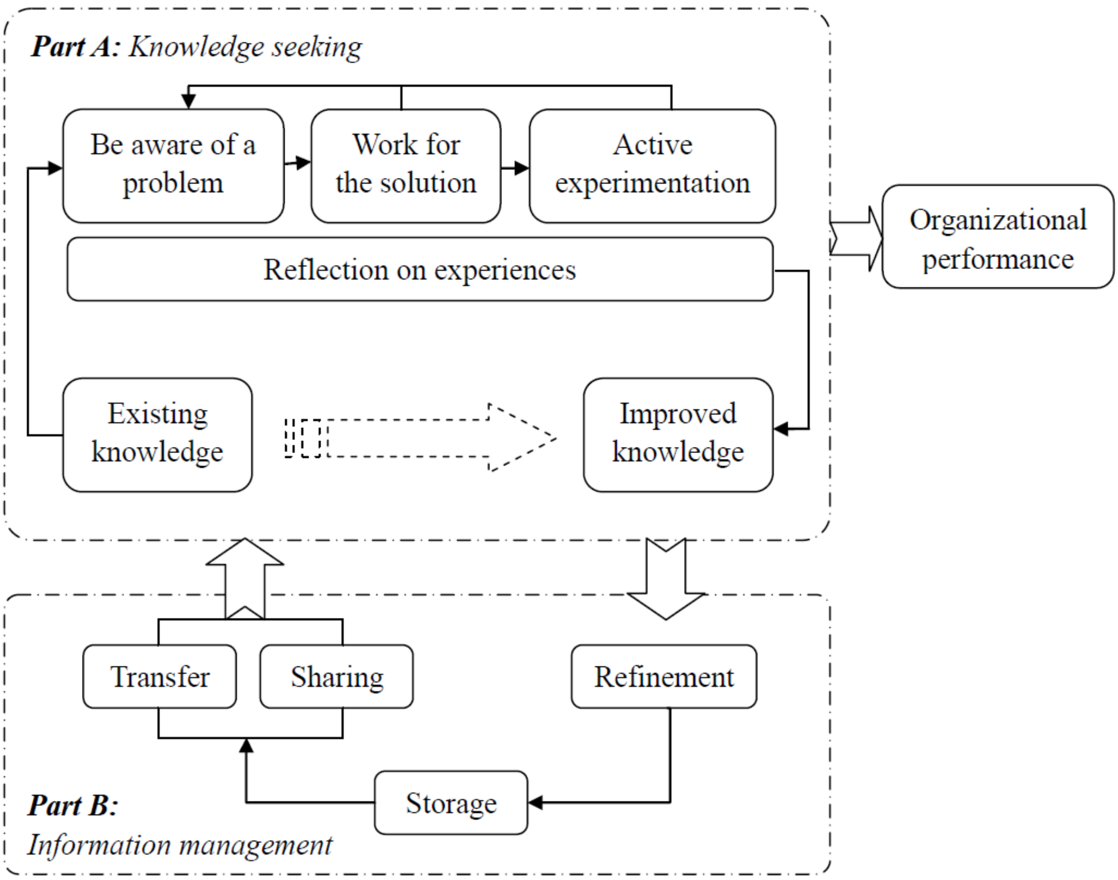


Figure 7-6: Knowledge seeking in the KM cycle

When the knowledge in our minds are refined, stored, transferred, and shared in the organization like in Part B in Figure 7-6, knowledge is actually reduced to the format of information or even data as we have discussed before. This part is thus a kind of information management and becomes a supportive component for a knowledge seeking process embedded in the whole knowledge management cycle. From this perspective, information management is a part of knowledge management, as knowledge management also compasses the cognitive and practice side of information use, namely the individual knowledge seeking process. It is the knowledge seeking process that develops the improvement of our knowledge in our mind by the help of information from outside our mind, and helps utilize knowledge in fulfilling tasks to improve organizational performance.

7-7 Chapter Summary

This chapter discussed the findings from the data analysis. The three themes, namely experiential learning, problem solving, and information seeking, have been confirmed by the interview data collected from construction engineers. Moreover, the analysis focusing on the knowledge seeking process in the workplace has demonstrated an integrated jigsaw by combining or linking all these themes together: knowledge sought from the experiences, experiences enriched via problem solving, problem solved with the help of information. These links demonstrated the complexity of how individuals gain knowledge, which again echoed the major argument of this thesis, namely it is the knowledge seeking rather than knowledge sharing, that makes knowledge transfer or knowledge creation possible.

Many process models have been developed to demonstrate how we seek information step by step. However, it is unknown from these studies how the information helps us to make sense or to develop our knowledge. This study has turned to focus on the different uses of the information rather than how and where the engineers seek information. The findings from this study have shown that there were different uses of information for knowledge seeking: 'For the current situation of the problem', 'For the requirements of solving the problem', 'Heuristic information', 'Guidance/Enlightenment', and 'Solution'. Based on this, information seeking becomes a part of knowledge seeking. When we encounter any problem during our work, we start a problem solving process, during which information becomes a kind of help for us, like product fodder or raw materials, to make sense of the problem and to work out solutions.

The findings also illustrated the importance of action taken in knowledge seeking. It therefore has to be emphasized here that it is the action in knowledge seeking that enables the abstraction of principles applied from specific instances to novel situations.

Based on the codes developed, a knowledge seeking process model has been constructed illustrating the knowledge seeking process step by step. This model conceptualised knowledge seeking by integrating the key elements of the process, which help us understand knowledge seeking in the workplace. At the end of this chapter, it was traced back to the knowledge management cycle mentioned in previous chapters. Based on the discussion of knowledge seeking in the knowledge management cycle, information management is regarded as a part of knowledge management. It is the knowledge seeking process that develops the improvement of our knowledge in our mind by the help of information from outside our mind, and helps utilize knowledge in fulfilling tasks to improve organizational performance.

CHAPTER EIGHT

Conclusions and Implications

8-1 Introduction

Considering the crucial role knowledge seeking plays in knowledge management, the purpose of this research was to explore such a process in the workplace by developing a knowledge seeking process model. This chapter draws the thesis to a conclusion. After a review of the process of this research, the main findings are stated. This is followed by a discussion of the contributions and implications of this research. At the end, the limitations of this research and the recommendation for future research will be mentioned.

8-2 Examination of the achievement of the research objectives

With an interest in knowledge management and cross-cultural research, the author started this journey to conduct a doctorial research. The initial proposal was to explore the impact of national culture on knowledge related behaviours. Bearing this in mind, literature in knowledge and knowledge management have been reviewed.

This has drawn the researcher's attention to the fact that many researchers or practitioners have emphasised the importance of knowledge sharing and transferring in knowledge management. Consequently, it is one of the main goals of KM initiatives to encourage and improve knowledge sharing within organizations. However, knowledge is special in nature. The review of the literature in knowledge and knowledge sharing has led the researcher to some fundamental questions regarding knowledge sharing dilemmas: this concerns the root of the barriers – why should I share? Existing knowledge or new knowledge, which is more crucial? Push or pull of knowledge, which is the start point during knowledge transfer? The answer to these questions made the researcher stand firmly on the position that it is knowledge seeking, rather than knowledge sharing, that makes knowledge transfer or knowledge creation possible. In other words, the active pull from seekers is the key point in the 'knowledge transfer' process.

However, existing research with regards to knowledge seeking is few in number. More importantly, they all regard knowledge as a noun, which shows no difference from information. According to them, knowledge is just over there (in books, documents, or database). What we need to do is to fetch it. Considering the extraordinary nature of knowledge, the existing knowledge seeking research has apparently simplified the knowledge seeking process. This led to the main question for this research: How can we better define and conceptualize knowledge seeking for effective management of knowledge in organizations?

Hereby, this research aimed to explore the knowledge seeking process in the workplace to answer the research question. Furthermore, four objectives were identified. In the following the achievement of the research objectives will be examined one by one:

1) To review the literature addressing the definition and meaning of knowledge and knowledge management to clarify the notion of 'knowledge seeking';

To achieve this objective, a thorough review with regards to knowledge and knowledge management was conducted, which includes the review of the nature of knowledge in knowledge management, the differences between data, information, and knowledge, and learning theories especially in a workplace. Based on literature reviewed, knowledge seeking was defined as

> ***'a learning process, or a process of constructing knowledge, which results in the improvement of the seeker's knowledge structure to solve problems or satisfy some goal'.***

This definition clarified the notion of knowledge seeking by distinguishing knowledge seeking in this research from other similar notions and even the information seeking in the existing literature. The concept of knowledge sourcing, knowledge acquisition and knowledge seeking in existing literature refer to finding out 'knowledge' from somewhere, which regards knowledge as something existing somewhere and the means to seek or find it out. This is no different to information seeking. Obviously, the meaning of knowledge seeking in this research is novel, and no existing research touches on it. Objective one has thus been achieved.

2) To review the literature concerning how knowledge is sought in a workplace in order to develop a preliminary framework for knowledge seeking;

Based on the review of literature concerning knowledge, knowledge management, information seeking, and workplace learning, three main themes emerged as being involved in the knowledge seeking process, namely experiential learning, problem solving, and information seeking. After a review of the literature concerning these three themes, the jigsaw links between them were identified. Based on these jigsaw links, a preliminary framework (see Figure 4-12 in p141) was developed. Furthermore, a key set of a priori codes were identified, which were applied to the data at the analysis stage. Objective two has thus been achieved.

3) To conduct time-line interviews among construction engineers in China in order to collect primary data for the understanding of knowledge seeking;

In order to explore what happens during knowledge seeking, that is, how we seek knowledge in a workplace, sense making theory was employed as a methodological guide for the design of this research. According to Dervin (1983), when people perceive that they are facing a situation in a particular time and space, they are able to construct a temporary ordered reality, which will guide their behaviour. As both internal and external behaviour, sense-making helps people construct or design their movement through time-space. Practically, the core technique of the sense-making approach in research is the ‘time-line interview’, which helps us understand what happens through time and space, and how and why things happen? After pilot interviews, the interview questions for this study then focused on the knowledge seeking process by anchoring the respondents in terms of real situations. Through identifying professional contacts, some construction engineers, as so-called knowledge workers, from four different organizations in the construction industry, located in three different cities in China, were approached by the researcher. Twenty six interviews were successfully conducted, which were all audio-recorded and then transcribed and analysed afterwards. Objective three has thus been achieved.

4) To develop a theoretical model conceptualizing knowledge seeking that integrates key elements of the process by analysing the data collected.

Considering the research aim and the way the data was collected, qualitative data analysis was adopted in this study, more precisely the method of template analysis. In this study, the a priori codes identified previously were applied to the first transcript in order to develop an initial template, which was then applied to all the other transcripts in order to develop the final form of the template. Based on this final template, a theoretical model was constructed (see Figure 7-5, in p261), which integrates key elements of the knowledge seeking and illustrates the process step by step. Objective four has thus been achieved.

8-3 Main findings

- **Links among the themes**

This research aimed to reconceptualise knowledge seeking in KM. Therefore, literature concerning knowledge, knowledge management was reviewed. Based on the review, three main themes were identified as being involved in the knowledge seeking process, namely experiential learning, problem solving, and information seeking. The data analysis not only confirmed the involvement of these themes during the knowledge seeking process, but also revealed the essential links among them.

The first link: knowledge is sought by our own reflection on our experiences. As stated by Hassell (2007), knowledge is always embodied and is always based on the experience of some individuals in a society. However, how can we increase our experiences? According to experiential learning theory (Kolb, 1984), we gain concrete experiences from 'active experimentation'. Namely, we use our knowledge to actively experiment in a real situation which in turn will enrich our experiences. However, it was not known from experiential learning what happens during the experimentations.

The findings from this research show that the experimentation is actually a process of taking action to solve the problem we might encounter during work. This leads to the second link: our experiences are enriched via solving problems. Only when we realize a problem exists, will we start a knowledge seeking process attempting to find a solution, carry out the solution, and as a result, enrich our experiences. By reflecting on our experiences, the knowledge in our minds gets improved.

The third link among the themes resides in the problem solving process, the link between information seeking and problem solving: We may need to seek information to help us in working on the solution for the problem. Information therefore plays a supportive role to help us, especially in identifying and analyzing the problem and generating the alternative solutions. It is these inter-connected themes that constitute the whole knowledge seeking process.

- **Some key findings in the knowledge seeking process**

Apart from the links between the themes, some other key findings in the knowledge seeking process should be taken into account as well. First of all, 'being aware of a problem' plays a crucial role in knowledge seeking process. Without the awareness of a problem, the problem solving process will not be triggered, the experience will not be enriched, and therefore knowledge will not be sought. 'Being aware of a problem' is actually the trigger or starting point for knowledge seeking.

Secondly, how information supports the problem solving. As mentioned, information seeking becomes a part of knowledge seeking in this study. The findings have identified different uses of information in the knowledge seeking process. When identifying and analyzing the problem, we may need information to help us make sense of the current situation, as well as the desired results of solving the problem, and how we can reach the desired results based on the current situation. After the problem has been identified and analyzed, we may still not be able to generate alternatives by ourselves. In this circumstance, further information will be needed for assistance. Information may be the direct solution, or it may be guidance/enlightenment from others.

Thirdly, taking action is found also important in problem solving. Based on the solution we have worked out in our mind previously, action will be taken to carry out the solution in the real world, attempting to solve the problem. Furthermore, the results will be evaluated to make sure the problem is solved, which is called 'verify the result'. It is this action taken in knowledge seeking that tests the feasibility of the solution by connecting the cognitive structure and the real social circumstances. It is also this action taken in knowledge seeking that enables the abstraction of principles applied from specific instances to novel situations.

- **Knowledge seeking process as a learning process**

The main findings of this research point to the answer to the research question. Knowledge seeking has been reconceptualised as a learning process and a process model integrating different elements has been developed. Based on the template codes developed from the data analysis (as shown in Table 6-3), the developed knowledge seeking process model (Figure 7-5) illustrates what happens in the knowledge seeking process and how this happens step by step. As shown in Figure 7-5, before knowledge seeking begins we normally have got some knowledge in mind which is called existing knowledge. Based on this knowledge, we may be aware of some problems when we are doing some tasks in the workplace although the way we become aware of a problem may vary: actively, passively, and by interactive discussion. Once a problem is found, we will normally work on it to find possible solutions, during which we will identify and analyze the problem first, generate alternatives next, and decide which solution will be applied last. After a possible solution is identified, active experimentation will be executed to test if the solution works for the problem, during which we normally carry out the plan first and then verify the result. After the problem gets solved, or does not get solved, our experiences have been enriched. By reflecting on our experiences, our knowledge structure will be improved, in other words, a knowledge seeking process is thus completed. In addition, information plays a supportive role during this process, especially when we are identifying and analyzing the problem we meet and generating alternative solutions for it. We may seek further information to help us make sense of the situation during the process.

8-4 Distinctiveness of the study

- **Knowledge seeking rather than knowledge sharing in KM**

The existing literature in knowledge management places importance on knowledge sharing. However, knowledge sharing has its dilemmas, as we may be reluctant to share, and knowledge can only be learned by the knowledge seekers rather than being pushed onto others. Based on the review of the nature of knowledge and knowledge management, the first distinctiveness of this study is the new perspective the researcher has held forth in knowledge management, namely, it is the knowledge seeking process rather than knowledge sharing, among others, that makes knowledge transfer or knowledge creation possible.

- **Reconceptualised knowledge seeking**

The existing literature concerning knowledge seeking is few in number. Furthermore, these researchers regard knowledge as a noun. This perspective on knowledge seeking seems no different to information seeking. For them, knowledge is just over there, in the books, documents, or database. Knowledge seeking refers to finding knowledge from somewhere. However, as knowledge is special and always personal, it can only be actively constructed by the seekers. Based on this, this research reconceptualised knowledge seeking and defined it as a learning process, which is totally different from existing knowledge seeking concepts, where little research touches on it. This is another distinctive aspect of the study.

- **Understanding of how information supports knowledge seeking**

Information behaviour research has long been conducted, by which even the few studies of existing knowledge seeking research have been influenced. These information behaviour research findings have explored in detail how we seek information in different contexts and what factors will influence our behaviours during the information seeking process. To the researcher's knowledge, however, none of them takes further steps to explore what we will do next after we find out the required information (This echoes back to the differences between information and knowledge). This study has extended our understanding into the use of the information and thus the further development of knowledge in our minds. Based on this, this research has extended information seeking research and developed it further to a higher level process, namely knowledge seeking.

- **Research in KM within construction industry in China**

The lack of literature on Chinese KM has long been noticed by researchers (Li-Hua, 2004). Developed from western countries, KM theories and research were introduced into China mainly after the 2000s. Collecting primary data from China, this research developed deep insights into knowledge seeking behaviour, by applying Western theories into a Chinese context. Furthermore, there are a limited number of empirical studies of KM in the construction industry, and it is still unknown how to enhance the sharing and exchange of knowledge harboured by senior professionals in the industry, let alone knowledge seeking research. This PhD research, investigating the knowledge seeking process among construction engineers, demonstrates distinctiveness of the study in the context of the construction industry.

- **Qualitative research by combining time-line interviews and template analysis**

In the existing literature, the timeline interview is often used in information science and is associated with inductive content analysis, as it serves both as an observational tool for identifying data in texts and as an analytic tool for assigning variables to categories in coding (Schamber, 2000). However, template analysis was adopted in this research after the data was collected via timeline interviews, as this PhD research aims to understand what happens in the knowledge seeking process, and how it happens, rather than generating quantitative data for statistical analysis, which is what content analysis normally does. The combination of timeline interviews and template analysis is distinctive and has demonstrated good results in this research.

8- 5 Contributions to knowledge and implications

- **Theoretical contributions and implications**

Based on a thorough review of the literature, this thesis argues that it is knowledge seeking rather than knowledge sharing that makes knowledge transfer or knowledge creation possible in knowledge management. This novel perspective contributes to existing knowledge management theories by extending KM research from the emphasis on knowledge sharing alone to knowledge seeking, which implies a new research area for researchers.

In existing literature, experiential learning, information seeking and problem solving have long been discussed. However, they tend to be studied separately more or less. This PhD research linked these three themes together by illustrating the jigsaw links between them. It is such links that constitute a knowledge seeking process. The concept of knowledge seeking has therefore been defined as a learning process consisting of experiential learning, information seeking and problem solving. A process model (Figure 7-5 in p261) has been developed which contributes to existing knowledge, and results in the provision of a theoretical framework for further research in this area. For example, comparative research can be designed among different nations or industries based on this framework to identify the differences and similarities and explore influential factors.

The combination of time-line interviews and template analysis also contributes to the existing body of knowledge, especially in the research methods area. It extended the application of sense-making theory, which is mainly used in information behaviour research and was accompanied by a content analysis. This specific application contributes to the existing body of knowledge by providing a new research method for further research.

- **Practical contribution and implications**

This new perspective on knowledge management and knowledge seeking itself implies that it is not enough just to emphasize knowledge sharing and the knowledge sharer, but instead we should pay more attention to the opposite side of knowledge sharing, to those who actively seek knowledge. To some extent this perspective is innovatory and will contribute to knowledge management initiatives and projects: we should not only pay attention to knowledge sharers, but also, if not more importantly, to the knowledge seekers in future management activities.

The knowledge seeking process model (figure 7-5 in p261) in this research illustrates detailed steps in knowledge seeking, which contributes to practice by helping us understand the process. Although there is still much work to do in understanding the process more deeply, it provides the leaders or managers of organizations with insight into how people seek knowledge in the workplace, which should improve the management to support the knowledge seeking process. For example, the findings suggest that being aware of a problem is the trigger of the knowledge seeking process. Bearing this in mind, managers can take action in organizations to assist their staff in finding problems in their work, or they can give them more challenging jobs, which should trigger their knowledge seeking process and thus improve knowledge creation in organizations.

Collecting primary data from China, this research developed deep insights into knowledge seeking behaviour, by applying Western theories onto construction engineers within a Chinese context. This adds a practical contribution to the Chinese construction industry, particularly regarding effective knowledge transfer between managers and engineers. For example, as argued in this research, knowledge seeking, rather than knowledge sharing, among others, is the key to the knowledge transfer process. Encouraging construction engineers to actively seek knowledge becomes very important for effective knowledge transfer in this industry.

8-6 Limitations and recommendations

Like all research, however, the scope of this study has its limitations. First of all, the data was collected from construction engineers in the construction industry in China. As a consequence, the research could be said to be limited to a single industrial sector or concerned with national characteristics to one degree or another. It is not known if the findings of this research can be generalized to a wider context like another industry or country. Therefore, at this stage, we would say that the findings from this study are restricted only in the construction industry in China. In this sense, it is recommended that the further research can be conducted in other industries or other countries. If any diversity is identified between different industries or countries, further comparative study can be conducted to explore the differences and the possible reasons can be further analyzed.

As this research has put forward a new insight into knowledge seeking and defined knowledge seeking as a learning process, this opens up a new field of research in knowledge management. It is suggested that the knowledge seeking process as defined in this research will draw more attention from KM researchers and practitioners due to the crucial role that knowledge seeking plays in knowledge management. Furthermore, as a process model has been developed, this provides a framework for further studies in knowledge seeking behaviour. Based on this framework, it is recommended that further research is carried out to explore the influential factors on knowledge seeking behaviours and the possible diversities, during the process, among different industries or nationalities. Along with this framework, further research into the knowledge seeking process will provide more and richer implications for practice and theoretical insights for knowledge management initiatives.

APPENDICES

Appendix A: Consent form for the interviews

Consent Form for Interviews

Please consider this information carefully before deciding whether to participate in this research.

Purpose of the research: To understand the experiences of seeking knowledge in the workplace.

What you will do in this research: If you decide to volunteer, you will be asked to participate in one interview. You will be asked several questions. Some of them will be about your educational and occupational background. Others will be about your experiences of seeking knowledge during your work. With your permission; I will audio record the interviews so I don't have to make so many notes. You will not be asked to state your name on the recording.

Time required: The interview will take approximately 30-45 minutes.
Risks: No risks are anticipated.
Benefits: This is a chance for you to tell your story about your experiences concerning how you gain knowledge during your work.
Confidentiality: Your responses to interview questions will be kept confidential. At no time will your actual identity be revealed. You will be assigned a code. Anyone else will only know you by this code. The recording will be destroyed as soon as it has been transcribed. The transcript, without your name, will be kept until the research is complete. The key code linking your name with your number will be kept in a very safe place, and no one else will have access to it. It will be destroyed after this research is completed. The data you give me will be used for my PhD research and may be used as the basis for articles or presentations in the future. I won't use your name or information that would identify you in any publications or presentations.

Participation and withdrawal: Your participation is completely voluntary, and you may withdraw from the study at any time without. You may withdraw by informing me that you no longer wish to participate (no questions will be asked). You may also skip any question during the interview, but continue to participate in the rest of the study.

To Contact the Researcher: If you have questions or concerns about this research, please contact: Han Lai. Phone: 0044 7877599028, Address: CEIS, Northumbria University, UK, Post Code: NE1 8ST. Email: han.lai@northumbria.ac.uk You may also contact the faculty member supervising this work: Mrs. Margaret Graham, CEIS, Northumbria University, UK, Post Code: NE1 8ST.

Agreement:

The nature and purpose of this research have been sufficiently explained and I agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty.

Signature: ______________________________________ Date: __________________

Name (print): ____

Appendix B: Transcripts of interview one (Chinese version)

A: 采访者　B: 被采访者_ZZ01
……
A:你能不能回忆一下，在你的工作中有什么让你印象比较深刻的，你觉得你学到了很多知识的事情。
B: 好的，太多了。......比如说有一次我们的一个暖气温控项目。有单位找到我们问我们能不能做暖气的温控。他们的办公楼安装了暖气，但是温度控制方面出了问题，需要解决。其实当时我从来没做过这种项目，可以说根本不会。但是因为这是一笔大业务，我们需要找到这样的项目才有钱赚。所以我就说，可以，我来看看。
A：你胆子很大哦
B: 是呀，没办法，必须要有业务嘛。就答应下来了说去看看。但是心里面是没底的。当时网络也没有像现在这么发达，现在很多专业讯息和资料都很容易在网上找到。当时没有，也不可能问别的单位，这种事情谁会告诉你呢。别人不可能告诉你，包括现在，就不可能告诉你，假如说你要懂，你想干这个活呢，
A: 你只能去自己钻
B: 只能自己钻，自己去摸索，
A: 哪你当时怎么办的呢？
A: 我首先就是到图书馆去找资料。在图书馆找到资料，找到资料以后。你看前面有涉及到温度，然后怎么实践，在一个因为它是水，怎么样变成气，怎么样变成水，这个工艺你首先要了解，你对这个温度，热交换，还有很多方面的知识，然

后完了以后，最后还要了解他的设备，因为它有现有的设备嘛，你不可能增加很多，我要了解他的问题，他最后提了一个要求，他有了很多设备，他现有的，他要利用它的设备，

A: 也就是说在业务员回答之前，你这些资料都全部摸索了一遍？

B: 就是我回答业务员一些问题之前，我必须我心里有数，能不能贷款，需要多少钱？这是最主要的。因为这就你好比业务员告诉我说行呀！我就去给别人谈去了，人家很直接呀，能不能，怎么能，他还得有理有据的给别人答复出来，当时我就是主管，对很多资料，就看你现在，就好比你现在弄这个，你肯定要跨好几个专业呢，一个专业都不解决问题

A: 这个花了多长时间？

B: 这个一般就是3-4天，因为现在考虑到买书的成本很高，我们郑州图书馆，专门有复印店，我复印了两张，因为你抄书不可能呀，一张3块也不知道4块，就复印那些就3块也不知道4块，但是它比买书便宜，几十块钱，而且它也不一定有那么全，所以我可能这一本书里我可能也就这一点有用，所以我啪一复印，我不在你这里买

A: 对，对

B: 我看着很多拿着复印的，因为一本书里面你可能就有一两个有用的

A: 那就是说你基本上就是在图书馆所有的这些你都借回来完了？

B: 恩，基本上至少是前期的，大概的，基本的轮廓已经有了，具体怎么实施也有了，这是前期的理论准备，

A: 恩。好，那你接下呢？

B: 接下来下一步还不是接活的问题，先和业主接触见面，从业主的人员，因为业主是对这个了解的，他的工艺过程，就是说怎么交换他肯定知道，在从他那地方去了解怎么交换的，因为这个他大概知道一些，但是具体不知道怎么实现，但是

他知道这里面是个怎么回事情，它有现成的东西，他多少是知道一些的。

B: 去图书馆主要是从理论方面的，从理论上行了，但是实际的和理论的还是差很远,我得从业主那里去套，具体实践上的一些东西。

A: 对对对

B: 只能说是套，他肯定具体怎么搞他不会告诉你，你想，你不懂你还来给我谈什么？在咱说的就是很直接了，

A: 你至少让他明白，你说怎么弄得，我们一般怎么弄得，就套出来了

B: 对对对,找业主在沟通吗，因为你把那个大至的理论说出来了，当我不懂，我去给你探讨，因为当时那个情况，我肯定心里要先有底了，我不能白摩呀，然后我可能直接问你你不会告诉我，我就旁敲侧击，从他的话里面自然就可以套出来，从他的言语中就可以套出来一些经验，反正当时和业主沟通和自己泡图书馆，基本上就整个完全了解了,至少是从理论上，头脑里...

A: 那接下来呢？

B: 基本方案完了以后就是我具体的实施。具体的实施过程中，还有达不到要求，达不到要求就得再...好比说，当时遇到一个问题，就是温度不满足要求，不满足的话就要找原因，因为什么原因不满足，不过这个时候就不怕了，慢慢来，因为已经进来了,合同拿下来了。现在只是实施中的问题了。

A: 也就是实施的时候，又碰到问题了？

B：肯定碰到了，因为满足不了人家的要求，这个很显然的，

A: 哪方面的要求，什么要求？

B: 好比一个简单的例子，你要25度，我啪15度，这会行？这个很简单的，我就是说，我要就是说，还有一个例子，我啪50度，怎么也降不下来，这是哪里的原因？

A: 温度降不下来？

B: 嗯，这是哪里的原因？这肯定是要找原因的，除非说他很低，你升不上去，这个肯定很直接的，

A: 那你当时具体地说，就谈你这个，你当时具体的是温度在下降还是在升高？

B: 他两个就是好比说，我们最以前的是温度就是不升高，就是不升高的结果，

A: 就是温度太低了，

B: 太低了，升不上去，这种结果，

A: 那它，你把这个整个东西安装之后

B: 对对，安装完了吗，

A: 那么在安装的过程当中有没有碰到什么问题？

B: 安装的过程中不存在，基本上你就是按照以前的设想去做的，安装刚开始基本上按照理论上走的，因为安装过程中，你像我们搞控制的，设备上的问题很少。安装完之后，调试的时候，遇到的问题。一般理论上来走呢，就是说碰到问题可能就是温度升不上去,问题就是当时温度太低了,升不上去，升不上来嘛，你看那20多度，是不是.

A: 当时你碰到这个问题，当时是怎么想着的？

B: 我要找原因，就是分析这个原因是怎么造成的，要找原因.

A: 然后也就是说你再找出这个原因，

B:对, 可是我自己找不到这个原因，我自己肯定找不到，

B: 对，我肯定找不着，因为这个大的系统我不知道怎么弄我就弄不上去，

A: 这个也是你当时碰到的问题，

B: 肯定碰到,这个怎么弄呢？我自己去找，因为这个还是不是很熟悉，不知道症结

在哪里。从理论上，也就是书本上也没有。（ ）还是不肯说，不知道问题在那？（ ）最常的鉴定（ ）这怎么弄得呢？在听他们怎么说

A: 那也就是说，在当时满足不了要求，你找原因，那么当时，找原因的过程当中又遇到的问题就是，找不到原因？

B: 找不到原因，对，这是肯定的，因为书上没有吗，因为开始书上没有介绍，这个项目其实已经超出我的范围了，因为我本身对工艺不了解，

A: 那这个时候你采取的措施是什么？

B: 找有经验的业主套，因为我不是说我的东西不好，我的东西就是好，就是升不上去，不知道

A: 那就是在你刚开始找不到原因的时候，你有没有想过其他的方法或什么，在找这个业主之前，你有没有找其他的方法，找其他的如图书馆，找什么？其他方法，

B: 图书馆，该了解得都已经了解到了，该了解的，我前期要接这个活的时候以前我该方方面面的我该考虑的，我接这个活以前，也就是他这个方方面面怎么实施具体的使用哪种物质，思路都有了，虽然没有形成文体东西，但是脑子里整个都有了，但是最终遇见的问题解决不了，解决不了就是超出我的控制范围了，那就只能找业主，探讨，

A: 为什么找业主呢？

B: 因为没有路了，其他人也不知道，因为我也不是搞这个工艺的，所以就只能找业主，找相关的工艺工程师，也就是业主的，他里面的工程师，比如他的社会科长呀或者这之类的,相当于他那里的工程师一类的，

A: 那你怎么找他们呢？

B: 还是套，这个东西，你肯定你要是说我弄不下来，那你干什么吃的？但是因为当时你不是很了解，你又不能给他说我不行，我不知道。因为本身第一次干，这

个东西，本身全图书馆之外，在实施上，不是很清晰，不是非常清晰，而且清晰了，但是不是非常清晰，就是模模糊糊，还有点模糊，

B: 现在出了这个问题，该我想的，我想办法，他就是还上不去，

A: 好，这是那你找了他之后有什么结果呢？

B: 就是套，我说，因为考虑起来它牵涉咱说的温度，他牵涉是蒸汽吗，它牵涉一个换热的问题，他的流量不够呀，压力不够呀，最后，只能告诉他还是有问题，我不能说我调节不好。所以说就是先套，你不可能直接，啊，你这个不行怎么怎么着，中国人含蓄嘛，你就是不行，咱也不能说不行，然后就是套，哦，最后他说，可能是牵涉着蒸汽，因为它是热水交换吗，有可能，你去其他地方看看是不是那个气压低？就是说他提醒你一点，告诉你，不是建议你。他最后给了几个思路，给你讲说可能是那几个地方，你去看看，去实地考察，

A: 那接下来呢？

B: 按照他说的去做了，去那一看，哦，原来他的压力低了。你看，这是我们看不到的。那个压力低了，肯定达不到负荷，因为他的热量，热量的东西等量交换吗，你那边到不了，这边肯定到不了。但是他就是，你看他现在他有很多方法，一个是压力低了，一个是管道堵了，一个是在热交换的过程中他的设备有问题，很多很多，大概不下10种，你的挨个一个一个查，但是每个地点你要和工程师去挖他的思路，因为10个问题，可能有10个专业，都不是一个专业，所以你就要跟进，然后找到症结：也不知道是压力低了，还是管道堵了,还是什么其他的问题。反正这个问题解决了，

A: 还有没有碰到其他的问题，

B: 这个里面，肯定还有呀，你比如说，这就是施工的细节，好比说温度的位置，我装哪个地方, 这个刚开始也不知道。

B: 这也不知道，

A: 那你最后是怎么解决的？

B: 最后我考虑到，这个也就是说是技术问题。就是温度他要考虑到热的传导，还有管道的通排性，这个很多很多...好比管道，从外面进来，从顶上下来；现在有的过来以后直接上，进来通过直接进来，从他这给弄上，由于他这从顶上在下来，从头上一下打上去，它这里头不一样。我遇到的问题就是到底在哪里装感应器的问题，怎么装装到哪里，是吧，在这个过程当中，就这一点，这个东西就算一个问题，

A: 好，这个问题你当时，恩，首先碰到这个问题的时候你是怎么看得？

B: 最开始，我不知道哪。这个东西就是书上没有的，这肯定书上没有的，你请教人家吧，人家甲方不管你呀，你主要你自己做哪都行，最后你考虑经过这个理论上还得考虑最佳方案，你的走向什么的，首先拿理论来套，最后我觉得，像这个六层的可以装到第二层就可以，下面第二层也可以，这个就是大差不差吗，这个东西就是说，你根据你自己的理论来设计方案，如果不合适我再换地方。其实就是在实际过程当中有时候是一种要不断的验证，有时候你觉得可能在这，一旦试了不行，也可以得到经验,即便你错了，你也得到了知识，这不行这本身就是个知识，对不对，在失败中获得经验,就像有人说得：你要善于分析别人的失败，你别光分析人家的成功。因为成功的例子不一样，失败的例子才能是一样的，你要分析人家的失败，这就是那个，从那中吸取经验。

A: 对...

……

Appendix C: Transcripts of interview one (English version; translated by the researcher)

A: the researcher B: Interviewee_ZZ01

…

A: Could you recall anything happened to you during your work, from which you think you have learnt a lot, or you think you got knowledge from it.

B: Ok. … There are many this kind things. En… for example, I have ever completed a project, which was to control the temperature of the central heating system in a building.

A: Fine, how did you get this project then?

B: One day, I received a phone call from a big company and was asked if we are able to do the temperature-control for the central heating system of their office building. There was a central heating system in their office building, but something wrong with it. It did not work properly. Actually, I had totally no idea about it at that time as I was not specialised in this area, and never did this kind job before. But you know, this was a big project for me at that time. We need jobs to earn money. So I replied him 'no problem', and said that I would come and have a look at it.

A: Woo, you are so brave.

B: oh, We need jobs, we have to. But to be honest, I had not got any clue at that time. You know, there was no internet like now, where we can easily get information or knowledge from it. And it is either impossible to ask others. Who would tell you how to do such job?! Nobody! Otherwise, they can do this job and get money.

A: so, how did you do it then?

B: I can only do it by myself. To study, to explore by myself.

A: How?

B: The first thing I did was to look for references or data from library. I went to library and found some references. You know, the heating system is about water, steam, and how they are converted from each other and controlled. You have to learn this procedure, how the heat is exchanged. How the water becomes steam, and how the steam becomes water. You should learn this procedure. You have to learn the theories and related knowledge about this procedure first. So I went to library first to learn these fundamental principles.

A: what else did you do?

B: I contact that company and asked more details about the system, and the problem, their requirements, and so on. They told me that they had installed many types of equipment in the system. They hoped that the repairment could be completed based on the existing equipments as far as possible. Anyway, I have searched all the references and related information before I replied to the company.

A: Why?

B: I have to get a plan in mind as for how much I might spend, how I am going to solve the problems. This is very important. As when I reply to the company, I will have to be able to tell them if I can do it and how I am going to do it. Only when they believe in that I can do it, will they give me this job. You know, this job involved many different subjects, so I have to review lots of references. It is really time-consuming.

A: How long did you spent in it then?

B: Woo, it took me about 3-4 days mainly in the library. I copied some useful references.

A: how did it help you?

B: It was really helpful. At least, I have got a general idea about the job, the basic principle, theories of the system, and how it works.

A: ok, what did you do next then? Start the job?

B: No, had not started yet. I went to the company to meet their engineers who is in charge of the system. Their job was to do the maintenance work. You know, as an engineer, they must know how the system works, and the processes. They might not know how to solve the problems, but they know more than me about the system. From library, I mainly learn the theoretical aspects of this job, while from the engineers I can learn the practical aspects of the system. You know, sometime, the theories and the practices are different. I have to learn something from the practical side.

A: yep…

B: But you know, they can only provide me some information about it, they have not the solution. Either, I cannot just ask them the solution directly, as I am requiring this job, how can I ask them for the solution?! Furthermore, if they find I know nothing about the system, I will definitely lose the chance. As I have learnt a lot from the references I found from library, I have got some ideas in mind. Then I went to see the engineers from the company and chat with them but have to speak in a roundabout way.

A: Did you get something from them?

B: Yes. I did. I learnt much useful information from them, which I connected with what I learnt from the library. Basically, after I learnt from library, and chatted with the engineers, I would say I had learnt a lot. At least, theoretically, I have got some ideas in mind.

A: So next?

B: As I have got plan or ideas in mind, and they agree to give me this job, the next is to complement my plan, to do what I think in mind.

A: Was it fine during complementation?

B: No, we still got some problems.

A: What were they?

B: The problem was the temperature. The temperature was too low. For example, the temperature should be 25 degree, but it was only 15 degree.

A: So the temperature is too low.

B: yes. Too low.

A: When did you find this problem?

B: After we installed all the equipments.

A: So you did not have any problem during your installation?

B: No. That was not difficult for us. We just installed the equipment according to what I designed, what I thought in mind before. After we installed everything, we began to debug the system. And we found this problem. The temperature is too low.

A: So what did you do then?

B: yah, of course, we had to find out the reason first. We tried to analyse why the temperature is so low.

A: ok.

B: But, I could not find out the reason at that time. You know, I actually did not know this kind system very well. What was the key for this problem? I had no idea at all. There was no answer from any book. There was nobody I could ask for.

A: then how did you solve it? Did you go to library again or tried to find out any other way?

B: I have got all the reference I can find from library before I start this project. It was no use to search in the library again I thought. The problem was actually beyond my ability at that time. It was out of my scope. Then I decided to chat with the engineers in the company again. Anyway, they actually knew the system more than me.

A: ok, how did you do that?

B: Again, I would not ask for the solution from them directly. I would not say I could not solve this problem. But I can discuss the problem with them. You know, at this stage, I have got this job. So I could discuss the problem with them more openly than before.

A: ok

B: So I chatted with them based on my knowledge about the system (which I learnt from library).

A: did you get any help from them?

B: Yes. They said there were many reason might casing this kind problem. And they suggested that it might be about the water flow, the pressure, and etc. Anyway, they gave me some ideas about it and remind me some possible reasons of the problem. But of cause, they did not know the answer either. Just gave me some clue some thought way.

A: ok, so what did you do then?

B: Based on our discussion, I went to check everything they mentioned. And finally, the problem solved. It was the pressure. The pressure was too low, so the heat could not be transferred properly. You know, this is beyond my area. How did I possible find out this reason by myself? I could never find out this answer. But they knew. They did the maintenance work; they had lots of ideas about the problem of the system. Anyway, the problem got solved finally.

A: Did you get any other problem?

B: of course. For example, the temperature sensor. Where should it be installed? I had no idea about it before.

A: How did you solve it?

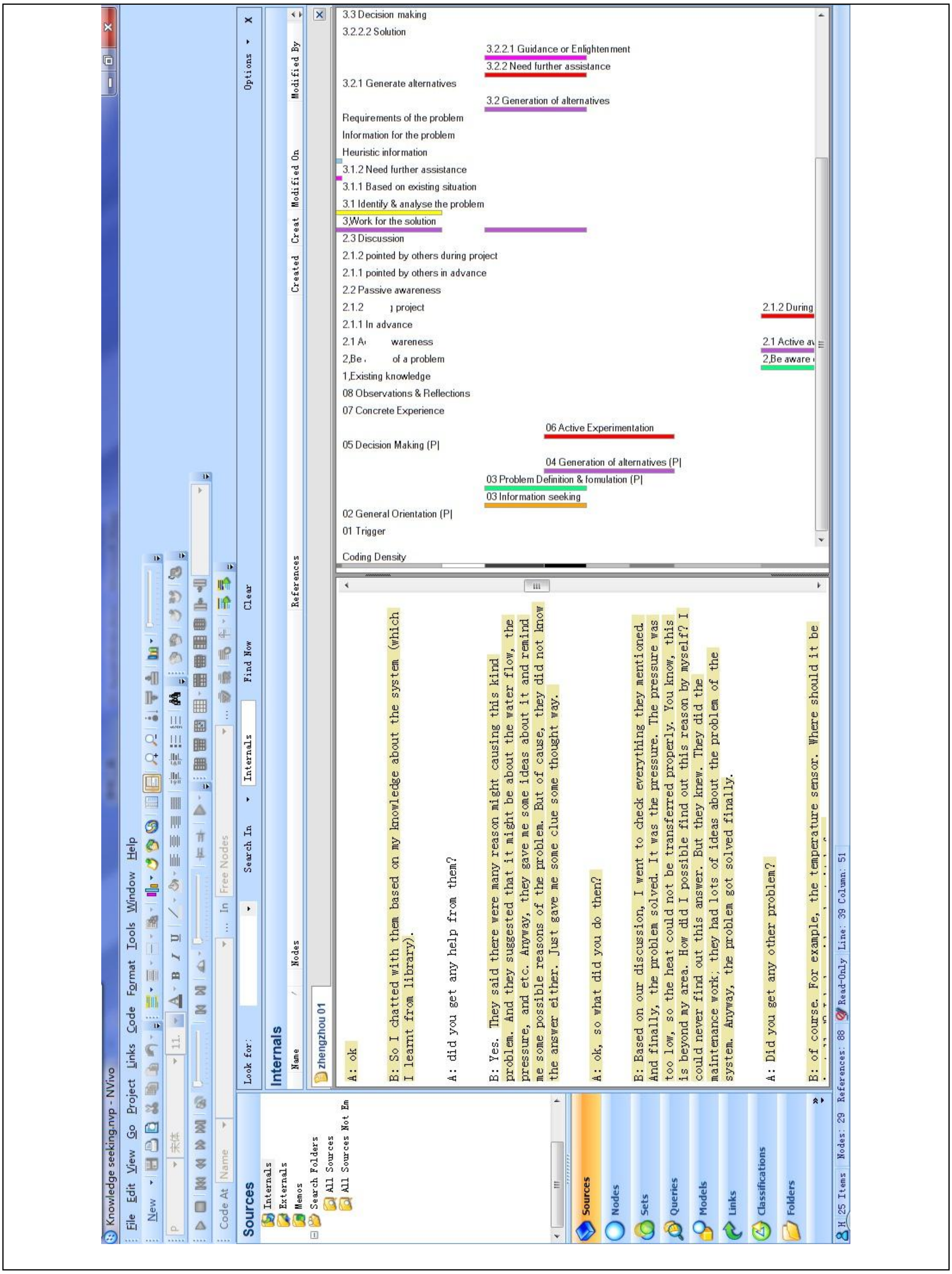
B: I worked it out by myself. I have learnt the theoretical aspects or fundamental principles of the system. Considering so many aspects of the system, for example, the pipe was installed from outside to inside of the building, or, some were installed from the top down to the building, anyway, there should it be proper?

A: How did you do then?

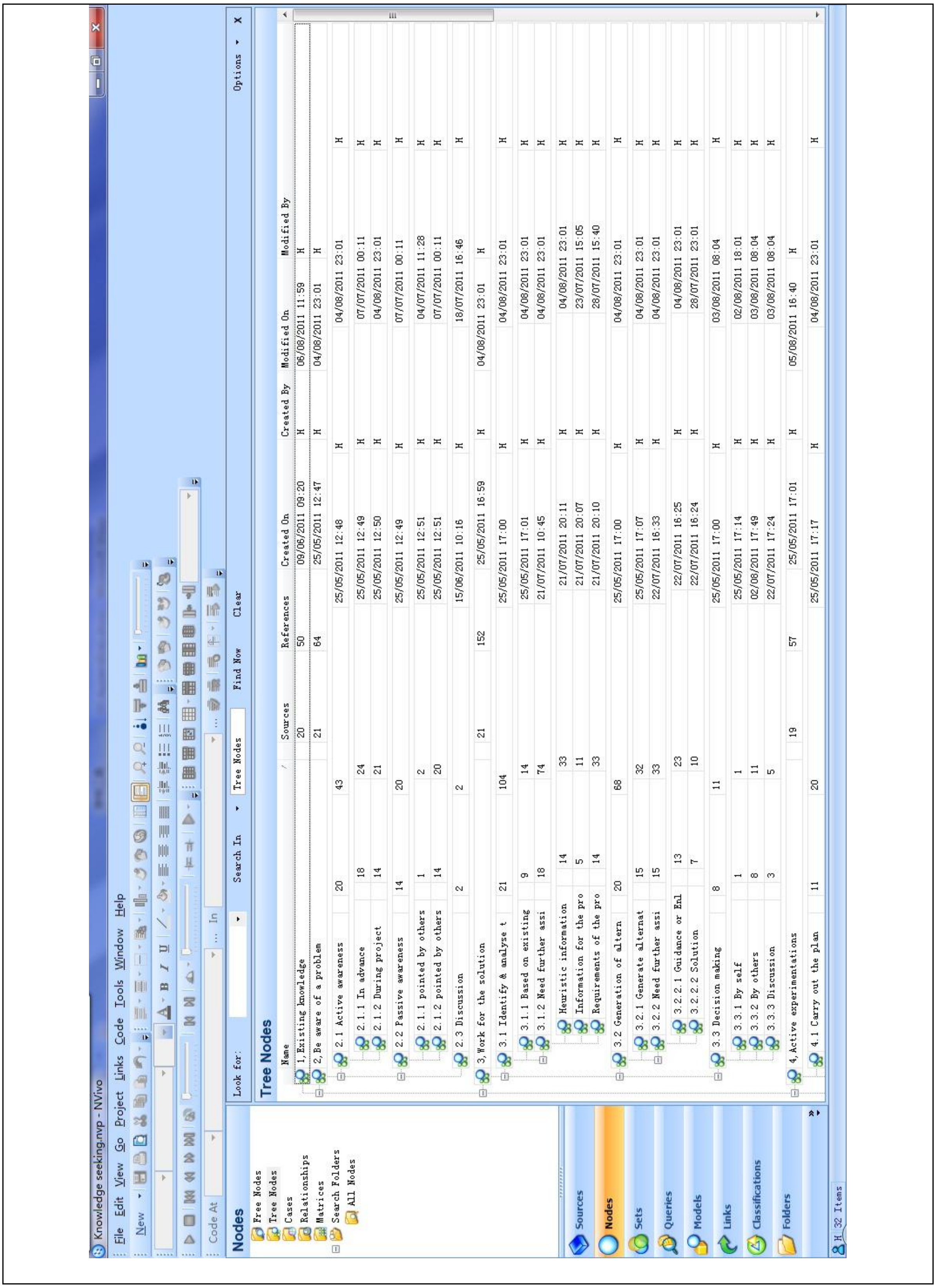
B: Again, I did not find any solution from the books, and nobody I could ask for. So I worked out the solution by myself, and tried it during the complementation. The second floor? Or the third floor? We did some experimentation. And finally, Find out the proper place. You know, in our work, we will normally try different way to solve a problem. You may find the final solution after you fail many times. Every time you fail, you could learn from it. Even if you were wrong, you can still get knowledge from it. As said by someone, we should analyze the failure more than successes, because the ways to success might be the same while the ways to failure are definitely different. Once we analyses the failure, we can get experiences and get knowledge.

A: yes…

Appendix D: An example of the coding from the transcripts



Appendix E: The Coding Tree



Appendix F：A list of published papers

Lai, H., Graham, M. (2008) 'National diversities in developing a supportive organizational culture for knowledge management: a comparative study between China and the UK', ***Technology management and innovation in China: Challenges and opportunities in the 21st century: 2008 CAMOT International Conference.*** **Beijing, China. 21st -23rd Oct. 2008. Volume 1, pp411-426**

Abstract:

This research explores the different cultural situation for knowledge management (KM) in China and the UK. Some critical cultural attributes are identified from current literature as key factors for a supportive culture for KM, namely, 'Team oriented', 'Trust', 'Working closely with others', and 'Sharing information freely'. Based on the perspective of 'person-culture fit', modified OCP is employed as a research instrument. It is assumed that a supportive culture will be created if these critical cultural attributes are nurtured in organizations. The conclusions from this study are, compared to the UK, China has advantages in creating a culture of 'Team oriented', and has disadvantages in creating a culture of 'Trust' for knowledge management in organizations. At the same time, both countries may be faced with the same challenges in creating organizational cultures of 'Sharing information freely' and 'Working closely with others' for knowledge management.

Keywords:

National culture, organizational culture, knowledge management, person-culture fit.

Lai, H., Graham, M. (2009) 'Knowledge seeking in knowledge management: towards an adapted KM cycle', ***in Proceedings of the 10th European conference on knowledge management,*** **University of Padua Vicenza, Italy. 3-4 Sept. 2009.**

Abstract:

Various disciplines have influenced and informed the field of knowledge management (KM) thinking and practices, therefore there are different KM perspectives and practices. Although a lack of consensus exists among these KM perspectives, the differences between them are not really that great: they are all regarding knowledge in organizations as a valuable strategic asset and trying to employ information and communication technology to capture and leverage knowledge to gain competitive advantage for organizations. These mainstream KM perspectives have called forth sharp criticism by some researchers who argue that KM is nonsense and is not different from information management. After reviewing previous KM perspectives and KM models, this paper discusses the key issues concerning knowledge, and the difference between knowledge seeker and knower. Based on the characteristics of knowledge and learning in workplace, the authors introduce a new concept into KM: knowledge seeking, and propose a new KM cycle, arguing that knowledge seeking, as a learning process, is the crucial part in knowledge management. This conceptual paper, providing a new perspective for organizations implementing knowledge management, enhances our understanding and development of KM research and practice.

Keywords:

Knowledge construction; knowledge Management; knowledge seeking; learning

Lai, H., Graham, M. (2009) A comparison of Chinese and UK cultural preferences supporting knowledge management in organizations. *The International Journal of Knowledge, Culture and Change.* 9(5), pp.139-150.

Abstract:

A supportive organizational culture has been recognised as a critical factor for a successful knowledge management (KM) initiative. This research explores the national diversities in developing such a supportive organizational culture between China and the UK. Some critical cultural attributes are identified from previous literatures as key factors for a supportive culture for KM, namely, ‘Team oriented’, ‘Trust’, ‘Working closely with others’, and ‘Sharing information freely’. It is assumed that a supportive culture will be created if these critical cultural attributes are nurtured in organizations. Based on the perspective of ‘person-culture fit’, a modified ‘organizational culture profile’ (OCP) is employed as a research instrument to explore the different organizational culture preferences among target samples from China and the UK. The conclusions from this study are, compared to the UK, China has preferences in creating a culture of ‘Team oriented’, and has difficulties in creating a culture of ‘Trust’ for knowledge management in organizations. At the same time, both countries may be faced with the same challenges in creating organizational cultures of ‘Sharing information freely’ and ‘Working closely with others’ for knowledge management.

Keywords:

National Culture, Organizational Culture, Person-culture Fit, Knowledge Management

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